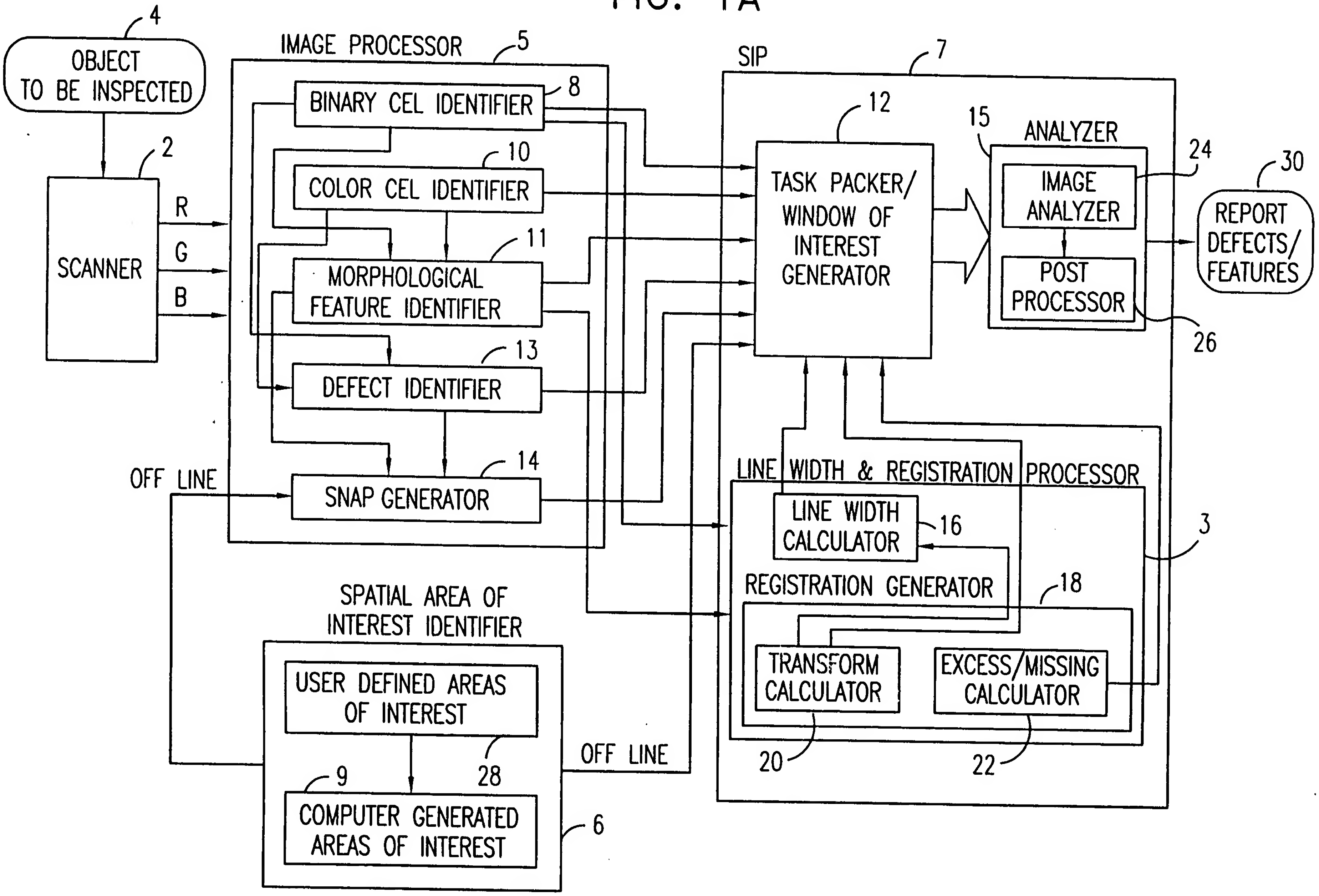
FIG. 1A


4
OBJECT TO BE INSPECTED
2
SCANNER
R
G
B
IMAGE PROCESSOR
5
BINARY CEL IDENTIFIER
8
COLOR CEL IDENTIFIER
10
MORPHOLOGICAL FEATURE IDENTIFIER
11
DEFECT IDENTIFIER
13
SNAP GENERATOR
14
OFF LINE
SPATIAL AREA OF INTEREST IDENTIFIER
USER DEFINED AREAS OF INTEREST
28
9
COMPUTER GENERATED AREAS OF INTEREST
6
OFF LINE
SIP
7
12
TASK PACKER/ WINDOW OF INTEREST GENERATOR
15
ANALYZER
IMAGE ANALYZER
POST PROCESSOR
24
26
30
REPORT DEFECTS/ FEATURES
LINE WIDTH & REGISTRATION PROCESSOR
LINE WIDTH CALCULATOR
16
REGISTRATION GENERATOR
18
TRANSFORM CALCULATOR
EXCESS/MISSING CALCULATOR
3
20
22

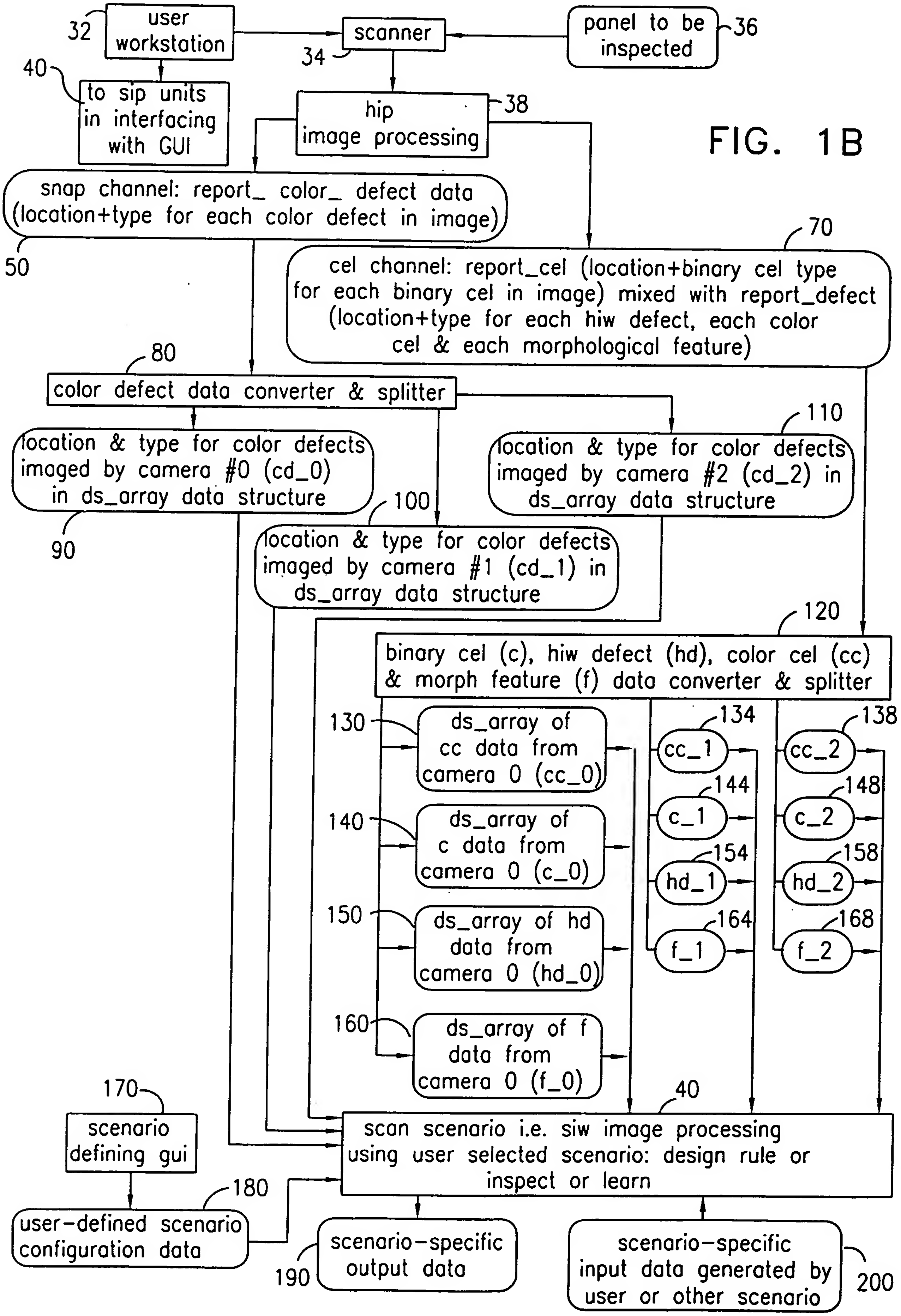

32
user workstation
scanner
34
panel to be inspected
36
40
to sip units in interfacing with GUI
hip image processing
38
snap channel: report_ color_ defect data (location+type for each color defect in image)
50
70
cel channel: report_cel (location+binary cel type for each binary cel in image) mixed with report_defect (location+type for each hiw defect, each color cel & each morphological feature)
80
color defect data converter & splitter
110
location & type for color defects imaged by camera #0 (cd_0) in ds_array data structure
location & type for color defects imaged by camera #2 (cd_2) in ds_array data structure
90
100
location & type for color defects imaged by camera #1 (cd_1) in ds_array data structure
120
binary cel (c), hiw defect (hd), color cel (cc) & morph feature (f) data converter & splitter
130
ds_array of cc data from camera 0 (cc_0)
134
cc_1
138
cc_2
144
c_1
148
c_2
140
ds_array of c data from camera 0 (c_0)
154
hd_1
158
hd_2
150
ds_array of hd data from camera 0 (hd_0)
164
f_1
168
f_2
160
ds_array of f data from camera 0 (f_0)
170
scenario defining gui
40
scan scenario i.e. siw image processing using user selected scenario: design rule or inspect or learn
180
user-defined scenario configuration data
scenario-specific output data
190
scenario-specific input data generated by user or other scenario
200

FIG. 1B

FIG. 2

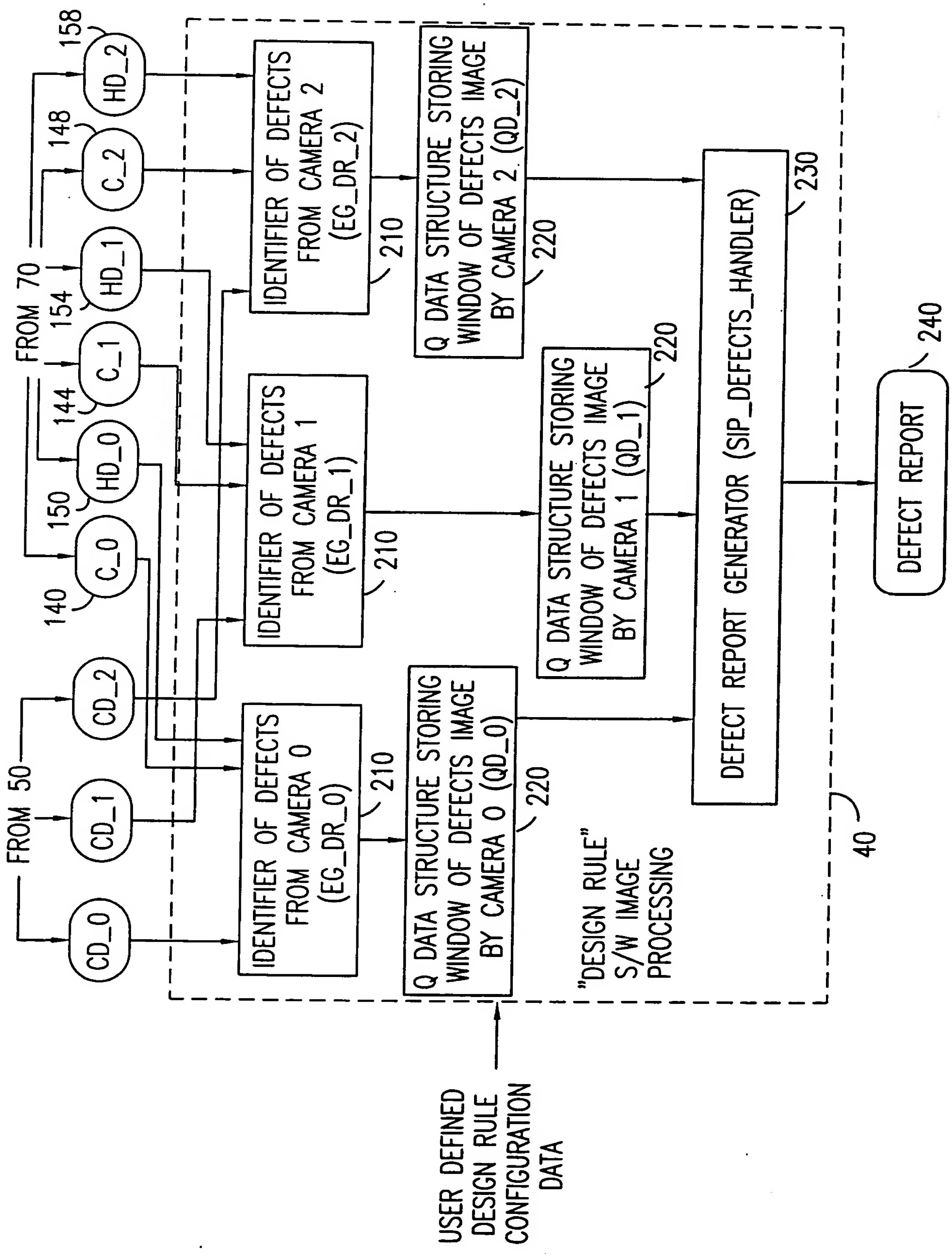
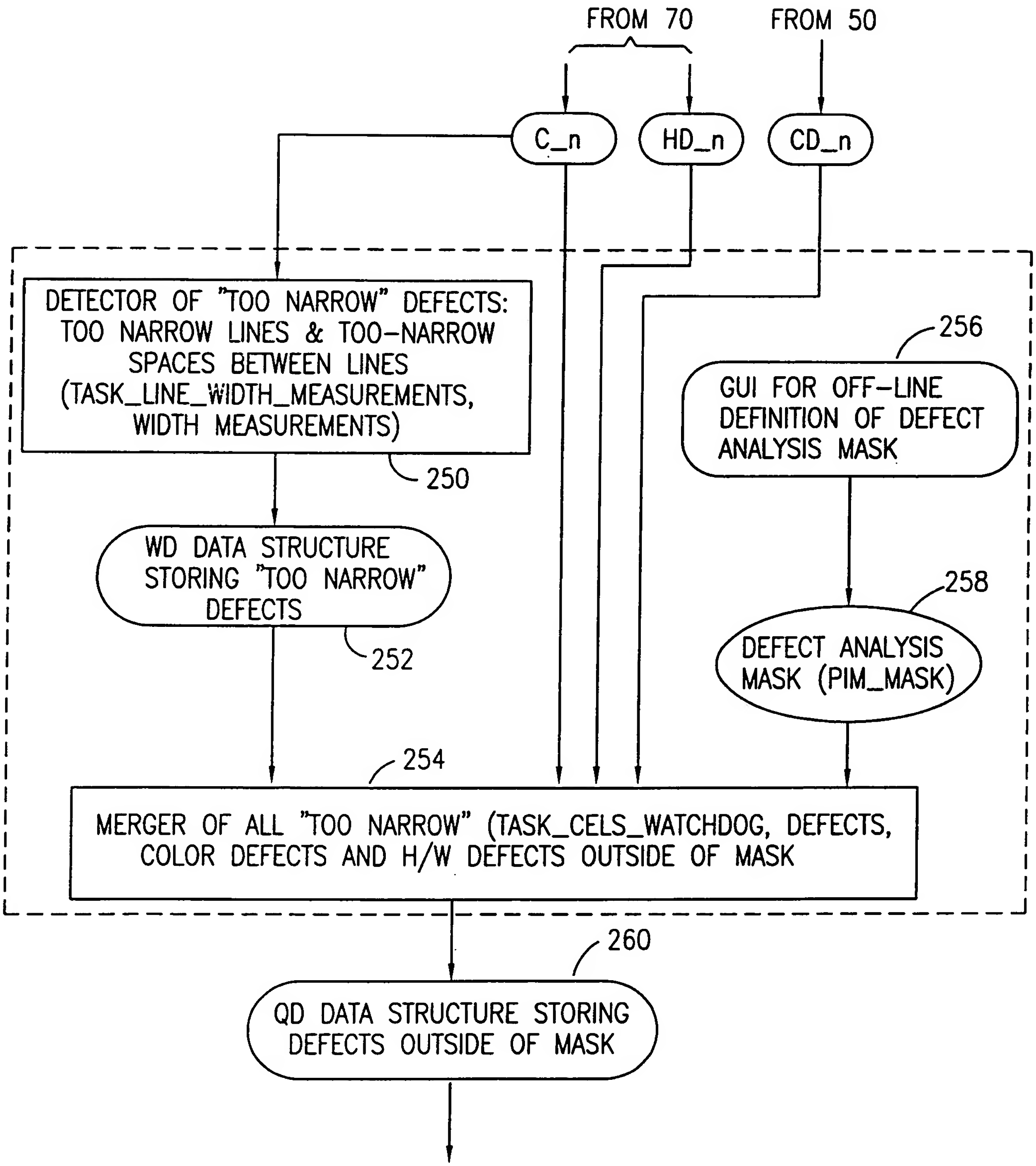

FROM 50
CD_0
CD_1
CD_2
FROM 70
C_0
HD_0
C_1
HD_1
C_2
HD_2
140
150
144
154
148
158
IDENTIFIER OF DEFECTS FROM CAMERA 0 (EG_DR_0)
IDENTIFIER OF DEFECTS FROM CAMERA 1 (EG_DR_1)
IDENTIFIER OF DEFECTS FROM CAMERA 2 (EG_DR_2)
210
210
210
Q DATA STRUCTURE STORING WINDOW OF DEFECTS IMAGE BY CAMERA 0 (QD_0)
Q DATA STRUCTURE STORING WINDOW OF DEFECTS IMAGE BY CAMERA 1 (QD_1)
Q DATA STRUCTURE STORING WINDOW OF DEFECTS IMAGE BY CAMERA 2 (QD_2)
220
220
220
DEFECT REPORT GENERATOR (SIP_DEFECTS_HANDLER)
230
DEFECT REPORT
240
"DESIGN RULE" S/W IMAGE PROCESSING
40
USER DEFINED DESIGN RULE CONFIGURATION DATA

FIG. 3


FROM 70
FROM 50
C_n
HD_n
CD_n
DETECTOR OF "TOO NARROW" DEFECTS: TOO NARROW LINES & TOO-NARROW SPACES BETWEEN LINES (TASK_LINE_WIDTH_MEASUREMENTS, WIDTH MEASUREMENTS)
250
256
GUI FOR OFF-LINE DEFINITION OF DEFECT ANALYSIS MASK
WD DATA STRUCTURE STORING "TOO NARROW" DEFECTS
252
258
DEFECT ANALYSIS MASK (PIM_MASK)
254
MERGER OF ALL "TOO NARROW" (TASK_CELS_WATCHDOG, DEFECTS, COLOR DEFECTS AND H/W DEFECTS OUTSIDE OF MASK
260
QD DATA STRUCTURE STORING DEFECTS OUTSIDE OF MASK

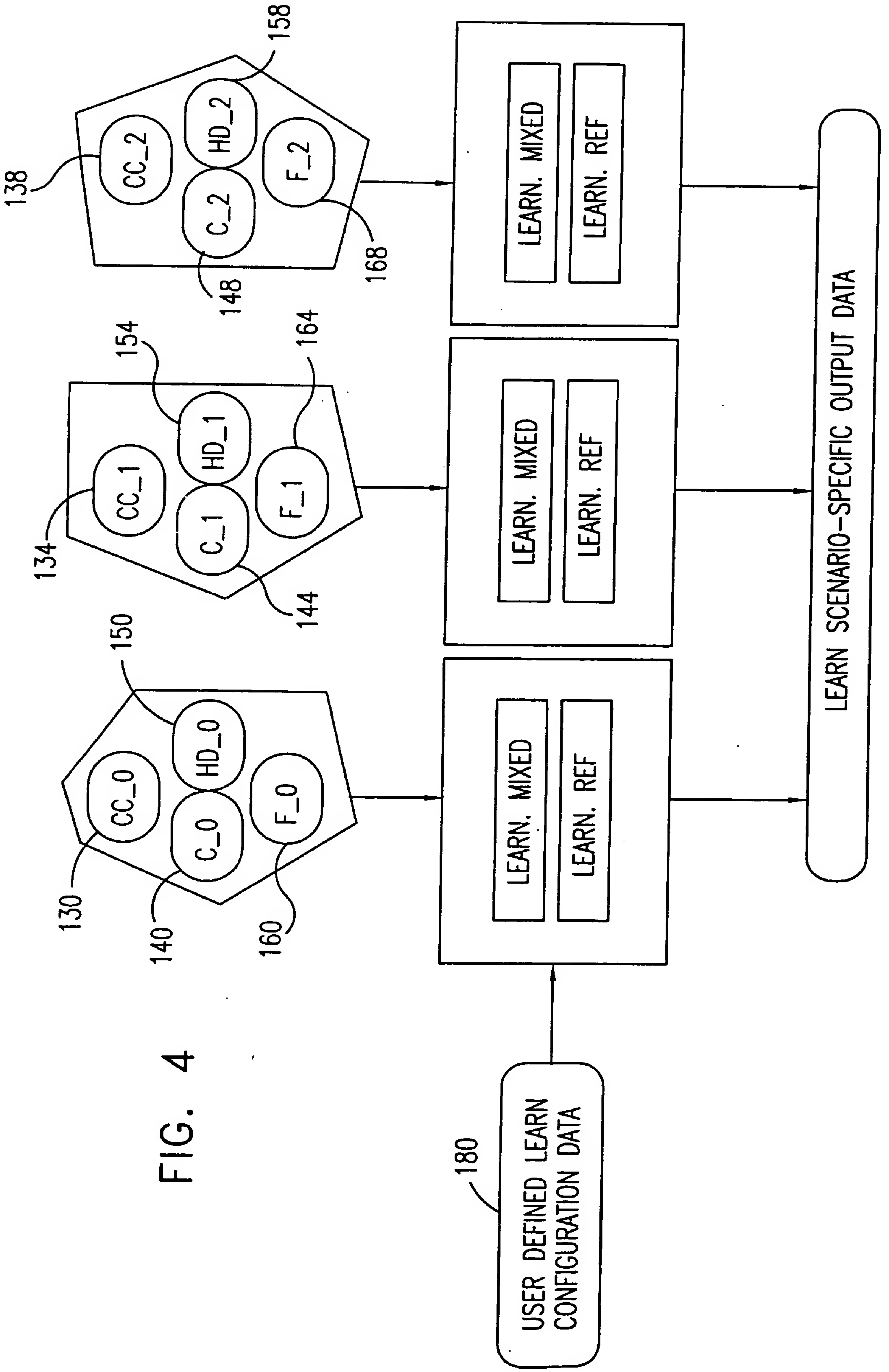

130
CC_0
C_0
HD_0
F_0
140
150
160
134
CC_1
C_1
HD_1
F_1
144
154
164
138
CC_2
C_2
HD_2
F_2
148
158
168
LEARN. MIXED
LEARN. REF
LEARN. MIXED
LEARN. REF
LEARN. MIXED
LEARN. REF
LEARN SCENARIO-SPECIFIC OUTPUT DATA
180
USER DEFINED LEARN CONFIGURATION DATA

FIG. 4

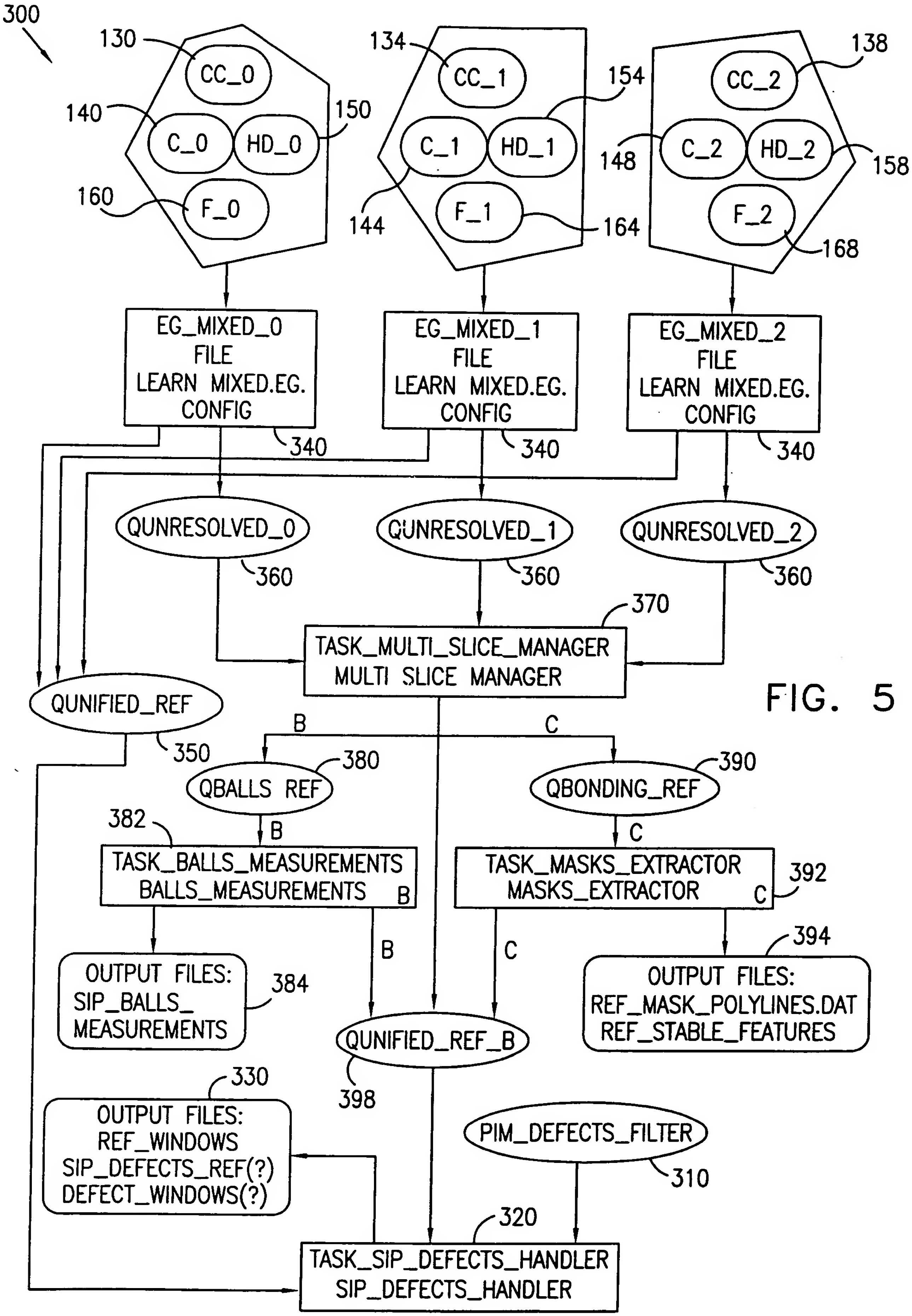

300
130
CC_0
140
C_0
HD_0
150
160
F_0
134
CC_1
154
C_1
HD_1
144
F_1
164
138
CC_2
148
C_2
HD_2
158
F_2
168
EG_MIXED_0 FILE LEARN MIXED.EG. CONFIG
340
EG_MIXED_1 FILE LEARN MIXED.EG. CONFIG
340
EG_MIXED_2 FILE LEARN MIXED.EG. CONFIG
340
QUNRESOLVED_0
360
QUNRESOLVED_1
360
QUNRESOLVED_2
360
370
TASK_MULTI_SLICE_MANAGER MULTI SLICE MANAGER
QUNIFIED_REF
350
B
C
QBALLS REF
380
QBONDING_REF
390
382
B
C
TASK_BALLS_MEASUREMENTS BALLS_MEASUREMENTS B
TASK_MASKS_EXTRACTOR MASKS_EXTRACTOR C
392
B
C
394
OUTPUT FILES: SIP_BALLS_ MEASUREMENTS
384
QUNIFIED_REF_B
OUTPUT FILES: REF_MASK_POLYLINES.DAT REF_STABLE_FEATURES
330
398
OUTPUT FILES: REF_WINDOWS SIP_DEFECTS_REF(?) DEFECT_WINDOWS(?)
PIM_DEFECTS_FILTER
310
320
TASK_SIP_DEFECTS_HANDLER SIP_DEFECTS_HANDLER

FIG. 5

FIG. 6

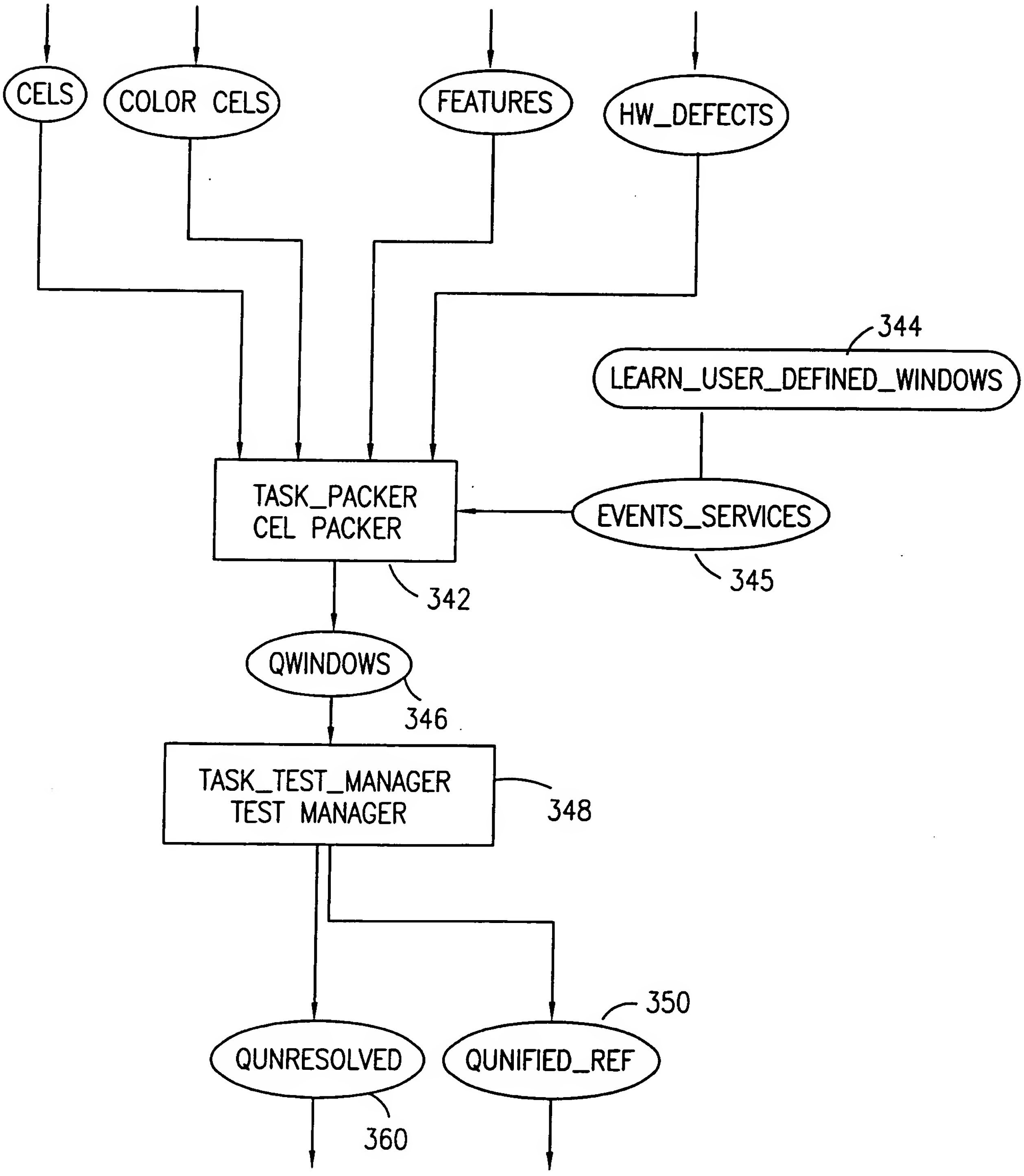

CELS
COLOR CELS
FEATURES
HW_DEFECTS
344
LEARN_USER_DEFINED_WINDOWS
TASK_PACKER
CEL PACKER
EVENTS_SERVICES
342
345
QWINDOWS
346
TASK_TEST_MANAGER
TEST MANAGER
348
350
QUNRESOLVED
QUNIFIED_REF
360

FIG. 7A

Window type	Functions attached	Remarks
target	target lrn: connect_closed (Func_connected_components<CEL>) vectorize (Func_angle_vectorizer<Cel>) target_reference (currently does nothing) trans2ref (Func_trans2ref) forward2target_analyze (Func_forward)	Produces connected components of raw CELs. Vectorizes them into polylines. Then transforms vectorized polylines into reference aligned coordinated system (removing all non transformable data). Finally the window is forwarded into destination unresolved and the function that is attached to the window at its new destination is target_analyze.
bonding _area	ii lrn connect_closed (Func_connected_components<CEL>) vectorize (Func_angle_vectorizer<CEL>) connect_open_color (only in enable_color_masking mode) (Func_connected_components<Color_cel>) vectorize_color (only in enable_color_masking mode) (Func_angle_vectorizer_<Color_cel>) stp_reference trans2ref (Func_trans2ref) forward2bonding_analyze (Func_forward)	Produces connected components of raw CELs, vectorizes them into polylines. If in enable_color_masking mode is then connected components of raw color CELs are also computed, and then vectorize them into polylines. The function stp_reference of type Func_stp_top_down_ref is called to learn bonding area and to create the single camera component of the reference including bonding pads windows, masks zones and stable features for registration. Then all transformable data is transformed into reference aligned coordinate system (removing all non transformable data). Finally the window is forwarded into destination unresolved and the function that is attached to the window at its new destination is bonding_analyze.
chip_area	nop (nop function)	Nothing is done with this window. It is only used within bonding_area window in function stp_reference.

FIG. 7B

Window type	Functions attached	Remarks
balls	balls ins connect_open (Func_connected_components<CEL>) vectorize (is needed only for debugging and visualization of balls algorithms) Func_angle_vectorizer<CEL>) circles_process (Func_circles_process) trans2ref (Func_trans2ref) forward2balls_analyze (Func_forward)	Produces connected components of raw CELs. Then vectorize them into polylines. This step is not really needed for the algorithm but it provides a nice picture to look at when visualizing the outcome of the algorithm. The function circles_process of type Func_circles_process is called to model the connected components as what are called generalized circles (balls). Then all transformable data is transformed into reference aligned coordinate system (removing all non transformable data). Finally the window is forwarded into destination unresolved and the function that is attached to the window at its new destination is balls_analyze.
cavity	alarms lrn watchdog-func (Func_watchdog) trans2ref (Func_trans2ref) forward2ref_if_in_camera (Func_forward)	Function watchdog checks to see if there are CELs inside the window. Any CEL found inside the window is reported as defect. Then all transformable data is transformed into reference aligned coordinate system (removing all non transformable data). Finally, if the window is completely within camera boundary then the window is forwarded into destination reference and the function that is attached to the window at its new destination is nop. If the window is not within camera boundary then the window is not forwarded.

FIG. 8

Function name	Functions executed	Remarks
balls_analyze	analyze_circles balls_create_ref balls_display (for display and debug only) merge_defects forward2balls_ref (Func_forward)	Classifies circles based on data coming from three cameras. Creates circles reference. Merges all defects from cameras into main unified data. Finally the window is forwarded into destination unified_balls_reference_defects_queue and the function that is attached to the window at its new destination is strip_balls.
bonding_analyze	analyze-bonding-side forward2bonding_ref (Func_forward)	Megre data from all three cameras into unified reference format. Finally the function is forwarded into destination unified_bonding_reference_defects_queue and the function that is attached to the window at its new destination is strip-bonding.
target_analyze	analyze_target forward2target_ref (Func_forward)	Megre data from all three cameras into unified reference format. Finally the function is forwarded into destination unified_reference_defects_queue and the function that is attached to the window at its new destination is strip_target.

FIG. 9

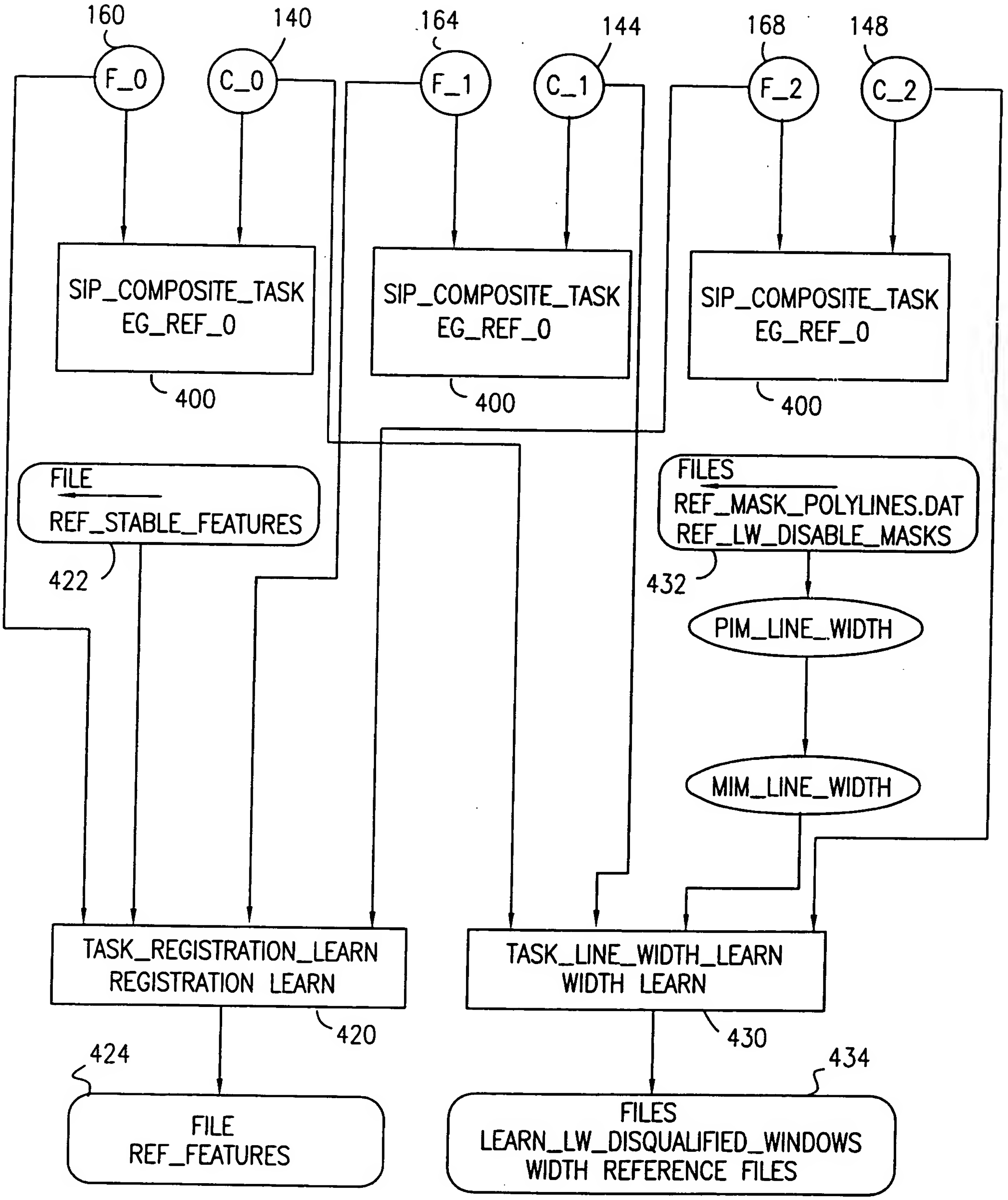

160
140
164
144
168
148
F_0
C_0
F_1
C_1
F_2
C_2
SIP_COMPOSITE_TASK
EG_REF_0
400
SIP_COMPOSITE_TASK
EG_REF_0
400
SIP_COMPOSITE_TASK
EG_REF_0
400
FILE
REF_STABLE_FEATURES
422
FILES
REF_MASK_POLYLINES.DAT
REF_LW_DISABLE_MASKS
432
PIM_LINE_WIDTH
MIM_LINE_WIDTH
TASK_REGISTRATION_LEARN
REGISTRATION LEARN
420
TASK_LINE_WIDTH_LEARN
WIDTH LEARN
430
424
FILE
REF_FEATURES
434
FILES
LEARN_LW_DISQUALIFIED_WINDOWS
WIDTH REFERENCE FILES

FIG. 10

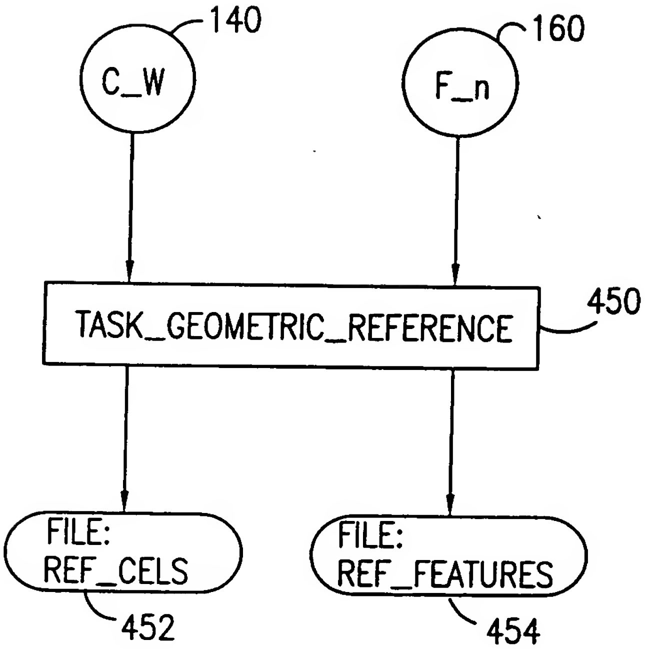

C_W
140
F_n
160
TASK_GEOMETRIC_REFERENCE
450
FILE:
REF_CELS
452
FILE:
REF_FEATURES
454

FIG. 11

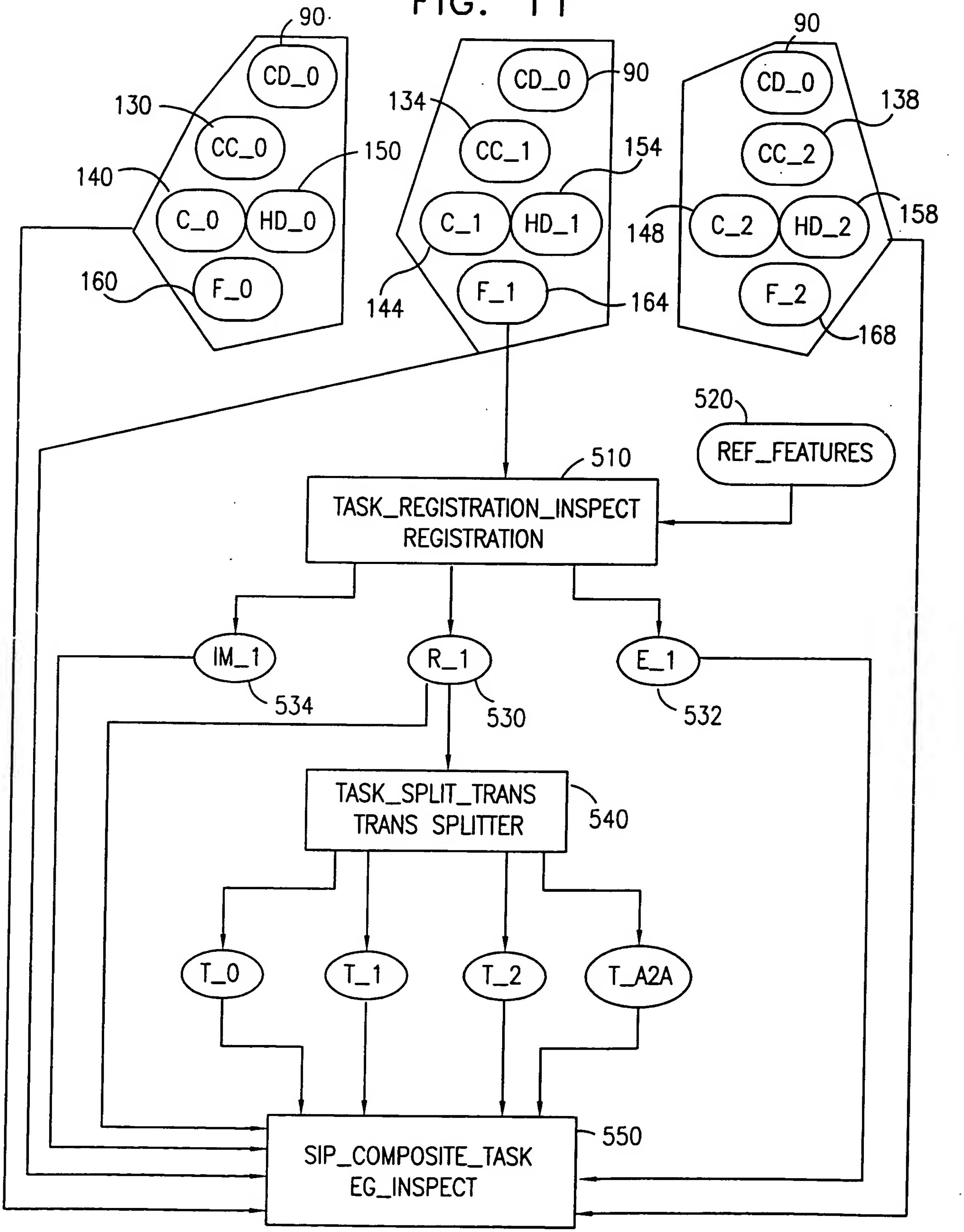

90
CD_0
130
CC_0
140
C_0
HD_0
150
160
F_0
CD_0
90
134
CC_1
154
C_1
HD_1
144
F_1
164
90
CD_0
138
CC_2
148
C_2
HD_2
158
F_2
168
520
REF_FEATURES
510
TASK_REGISTRATION_INSPECT
REGISTRATION
IM_1
534
R_1
530
E_1
532
TASK_SPLIT_TRANS
TRANS SPLITTER
540
T_0
T_1
T_2
T_A2A
550
SIP_COMPOSITE_TASK
EG_INSPECT

FIG. 12

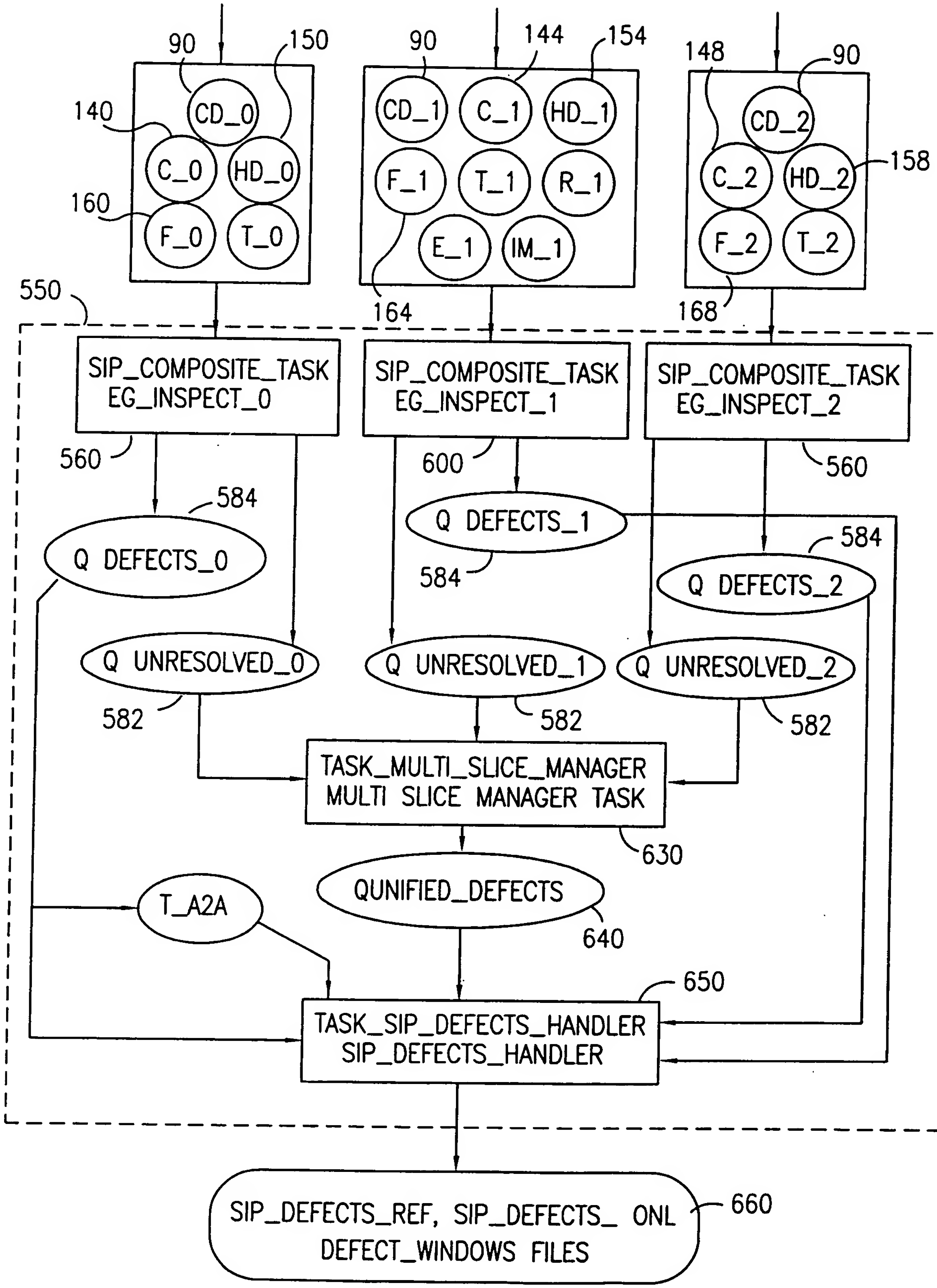

90
150
140
160
CD_0
C_0
HD_0
F_0
T_0
90
144
154
CD_1
C_1
HD_1
F_1
T_1
R_1
E_1
IM_1
164
148
90
158
CD_2
C_2
HD_2
F_2
T_2
168
550
SIP_COMPOSITE_TASK
EG_INSPECT_0
SIP_COMPOSITE_TASK
EG_INSPECT_1
SIP_COMPOSITE_TASK
EG_INSPECT_2
560
600
560
584
Q DEFECTS_0
Q DEFECTS_1
584
584
Q DEFECTS_2
Q UNRESOLVED_0
Q UNRESOLVED_1
Q UNRESOLVED_2
582
582
582
TASK_MULTI_SLICE_MANAGER
MULTI SLICE MANAGER TASK
630
QUNIFIED_DEFECTS
640
T_A2A
650
TASK_SIP_DEFECTS_HANDLER
SIP_DEFECTS_HANDLER
SIP_DEFECTS_REF, SIP_DEFECTS_ ONL
DEFECT_WINDOWS FILES
660

FIG. 13

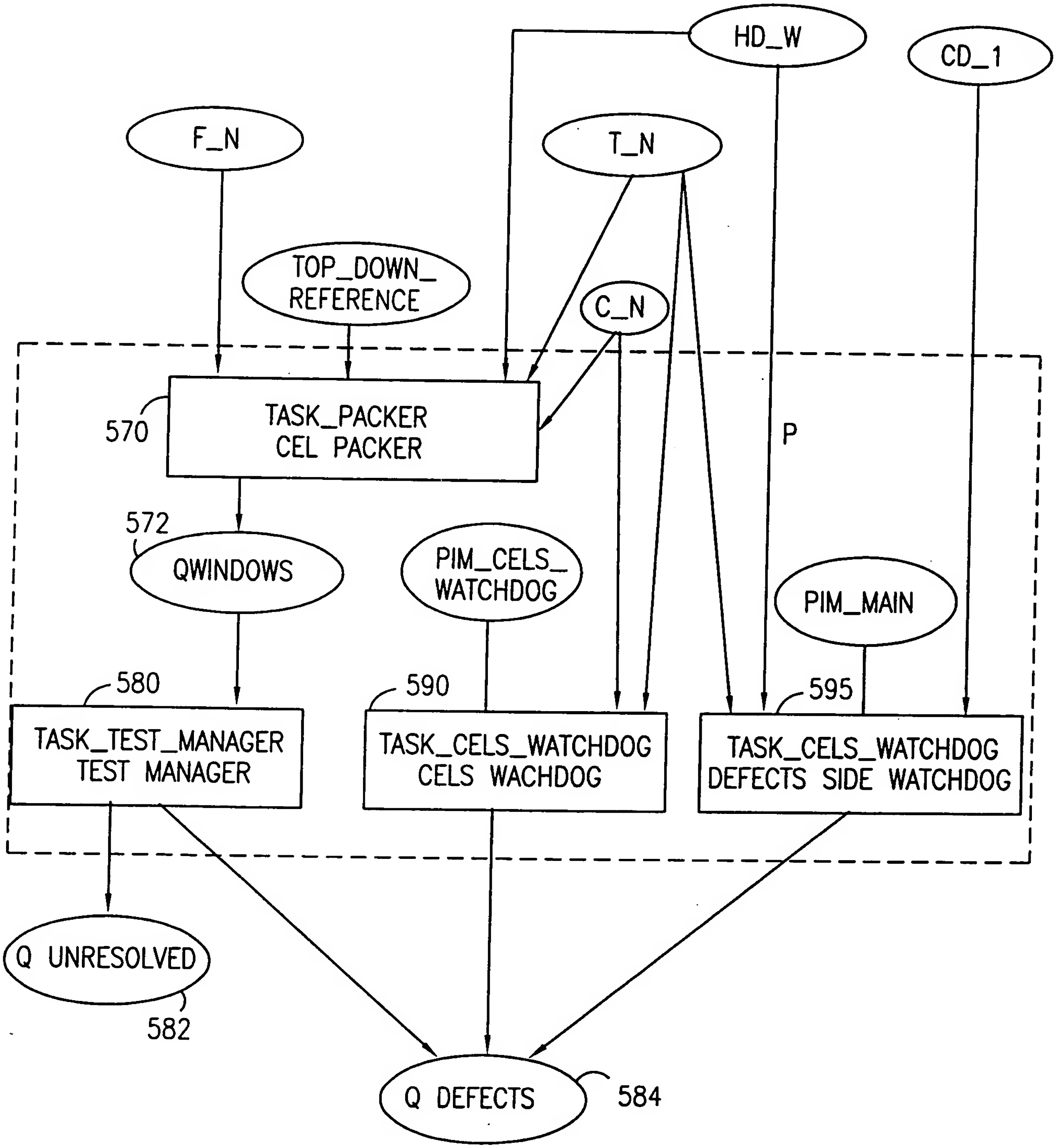

HD_W
CD_1
F_N
T_N
TOP_DOWN_
REFERENCE
C_N
570
TASK_PACKER
CEL PACKER
P
572
QWINDOWS
PIM_CELS_
WATCHDOG
PIM_MAIN
580
590
595
TASK_TEST_MANAGER
TEST MANAGER
TASK_CELS_WATCHDOG
CELS WACHDOG
TASK_CELS_WATCHDOG
DEFECTS SIDE WATCHDOG
Q UNRESOLVED
582
Q DEFECTS
584

FIG. 14

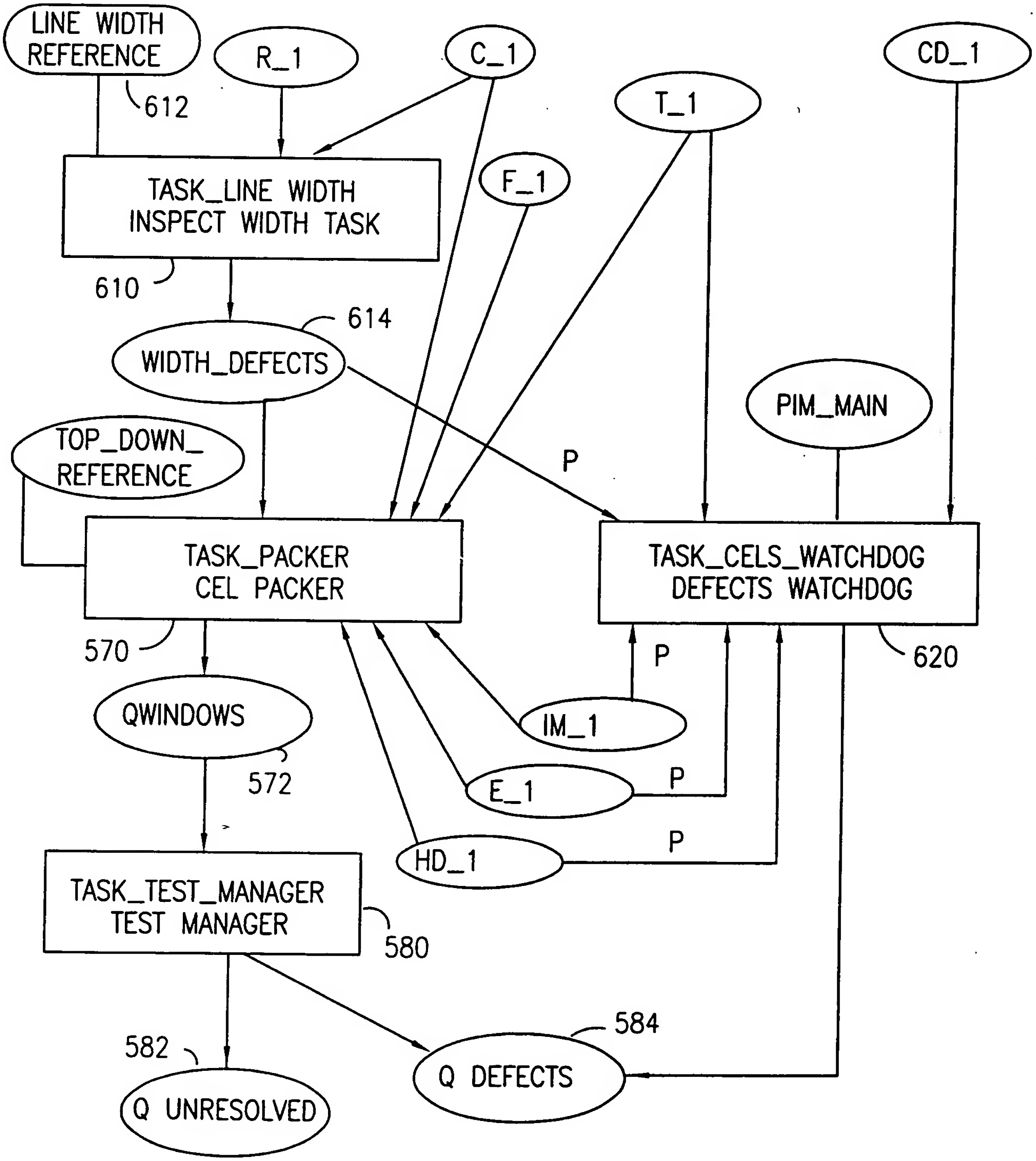

LINE WIDTH REFERENCE
612
R_1
C_1
CD_1
T_1
F_1
TASK_LINE WIDTH INSPECT WIDTH TASK
610
614
WIDTH_DEFECTS
PIM_MAIN
P
TOP_DOWN_ REFERENCE
TASK_PACKER CEL PACKER
TASK_CELS_WATCHDOG DEFECTS WATCHDOG
570
P
620
QWINDOWS
IM_1
572
E_1
P
HD_1
P
TASK_TEST_MANAGER TEST MANAGER
580
584
582
Q DEFECTS
Q UNRESOLVED

FIG. 15A

Window type	Functions attached	Remarks
target	poly compare target: polylines_comp_aaa_target (func_polylines_comp_aaa) defects_handler (Func_defects_handler) defectsfilter (Func_defects_filter) forward2defects (Func_forward)	Function polylines_comp_aaa_target of type func_polylines_comp_aaa do a CEL2VEC comparison between reference polygons and online CELs based on application target tolerances. Function defects_handler of type Func_defects_handler is a post processing function that decides which of the defects reported by the various defect detectors (nick, protrusion, width defect CEL2VEC, excess/missing, etc.) are real Sip_defects. Defects found by a detector are rechecked according to zone specific application criteria. Function defectsfilter is of type Func_defects_filter is called to filter out any defects. It uses PIM_main and filters out all defects found in one or more regions of the following: unstable, mask_region, power_line_default. Finally, if any Sip_defects are inside the window, then the window is forwarded into destination defects and the function that is attached to the window at its new dimension is nop (nothing to do). If no defects are found, then the window is not forwarded at all.
pad_ref	poly compare pads polylines_comp_aaa_target (func_polylines_comp_aaa) defects_handler (Func_defects_handler) defectsfilter(Func_defects_filter) forward2defects(Func_forward)	This function connected to this window type is similar to the function connected to the target window above. The only difference is that parameter applications are used for bonding pads to control the behavior of the CEL2VEC function.

FIG. 15B

Window type	Functions attached	Remarks
balls	balls ins connect_open (Func_connected_components<CEL>) vectorize (is needed only for debugging and visualization of balls algorithms) Func_angle_vectorizer<CEL>) circles_process (Func_circles_process) trans2ref (Func_trans2ref) forward2balls_analyze (Func_forward)	Produces connected components of raw CELs. Then they are vectorized into polylines. This step is not really needed for the algorithm but it provides a nice picture to look at when visualizing the outcome of the algorithm. The function circles_process of type Func_circles_process is called to model the connected components and are called generalized circles (balls). Then all the transformable data is transformed into reference aligned coordinate system (removing all non transformable data). Finally the window is forwarded into destination unresolved and the function that is attached to the window at its new destination is balls_analyze.
cavity	watchdog watchdog_func (Func_watchdog) defectsfilter (Func_defects_filter) forward2defects (Func_forward)	Function watchdog checks to see if there are CELs inside the window. Any CEL which is found inside the window is reported as a defect. Function defectsfilter is of type Func_defects_filter is called to filter out any defects. It uses PIM_main and filters out all defects found in one or more regions of the following: unstable, mask_region, power_line_default. Finally, if any Sip_defects are found inside the window, then the window is forwarded into destination defects and the function that is attached to the window at its new destination is nop (nothing to do). If no defects are found, then the window is not forwarded at all.

FIG. 15C

Window type	Functions attached	Remarks
reject	poly compare and reject polylines_comp_and_reject (func_polylines_comp_aaa) Forward2defects (Func_forward)	Function polylines_comp_and reject does a CEL2VEC comparison between reference polygons and online CELs based on application target tolerances. This function has a very small limit to the number of excess CELs or missing envelopes permitted. If there is even a small change between reference target and online target overflow type defects are obtained which are interpreted by the application as an indication that this frame should be rejected. Finally, if any Sip_defects is found inside the window, then the window is forwarded into destination defects and the function that is attached to the window at its new destination is nop (nothing to do). If no defects are found, then the window is not forwarded at all.
disqualified _lw_win	nop	Do nothing

FIG. 16

Function name	Functions executed	Remarks
balls_analyze	analyze_circles (Func_circles_analyze) balls_compare2ref (Func_compare2ref) balls_display (for display and debug only. Func_display_balls_info) Merge_defects (Func_merge_defects) forward2defects (Func_forward)	Classify circles based on data coming from three cameras. Compare unified circles to reference. Merge all defects from cameras into main unified data. Finally, if any Sip defects are found inside the window, then the function is forwarded into destination defects and the function that is attached to the window as its new destination is nop (nothing to do). If no defects are found, then the window is not forwarded at all.

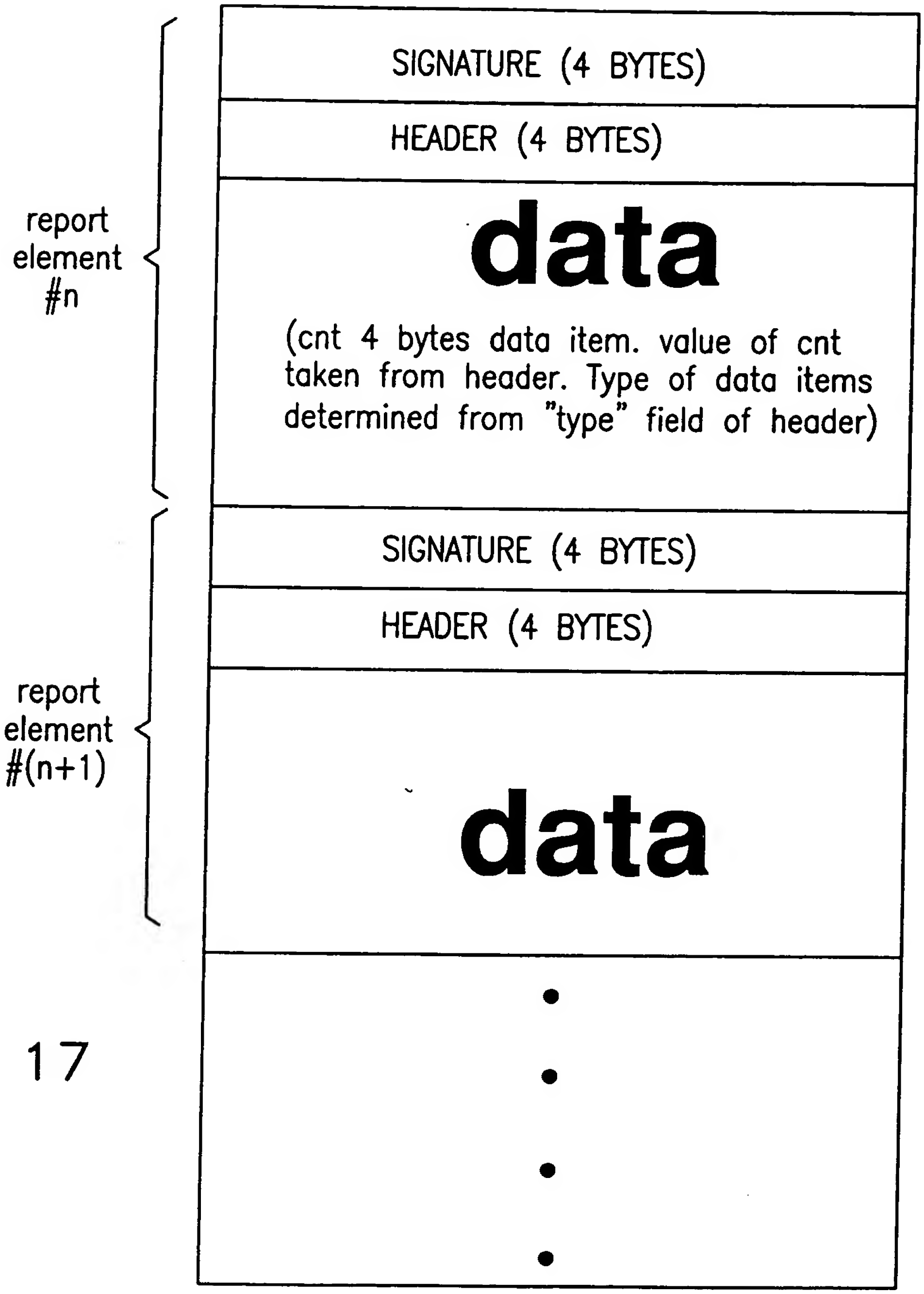

SIGNATURE (4 BYTES)
HEADER (4 BYTES)
data
(cnt 4 bytes data item. value of cnt taken from header. Type of data items determined from "type" field of header)
SIGNATURE (4 BYTES)
HEADER (4 BYTES)
data
report element #n
report element #(n+1)

FIG. 17

FIG. 18

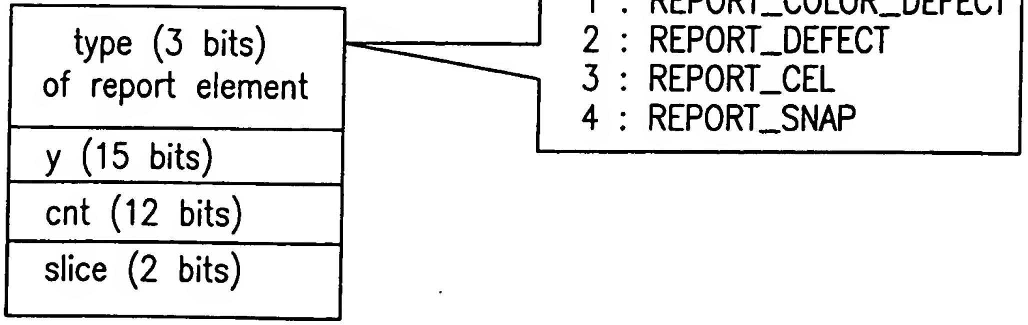
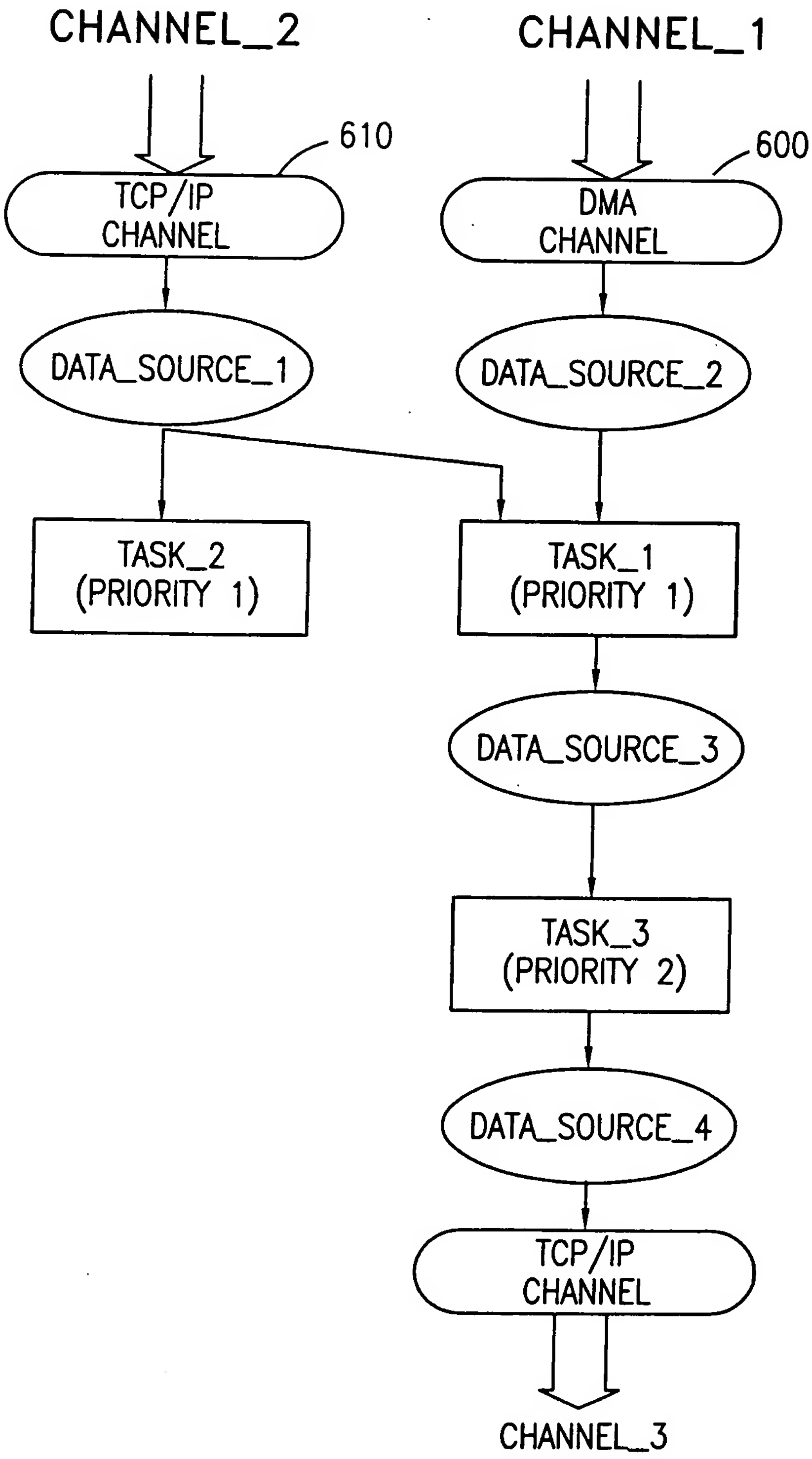

type (3 bits) of report element
y (15 bits)
cnt (12 bits)
slice (2 bits)
legal values for type
0 : REPORT_NO_TYPE
1 : REPORT_COLOR_DEFECT
2 : REPORT_DEFECT
3 : REPORT_CEL
4 : REPORT_SNAP

FIG. 19


CHANNEL_2
CHANNEL_1
610
600
TCP/IP CHANNEL
DMA CHANNEL
DATA_SOURCE_1
DATA_SOURCE_2
TASK_2 (PRIORITY 1)
TASK_1 (PRIORITY 1)
DATA_SOURCE_3
TASK_3 (PRIORITY 2)
DATA_SOURCE_4
TCP/IP CHANNEL
CHANNEL_3

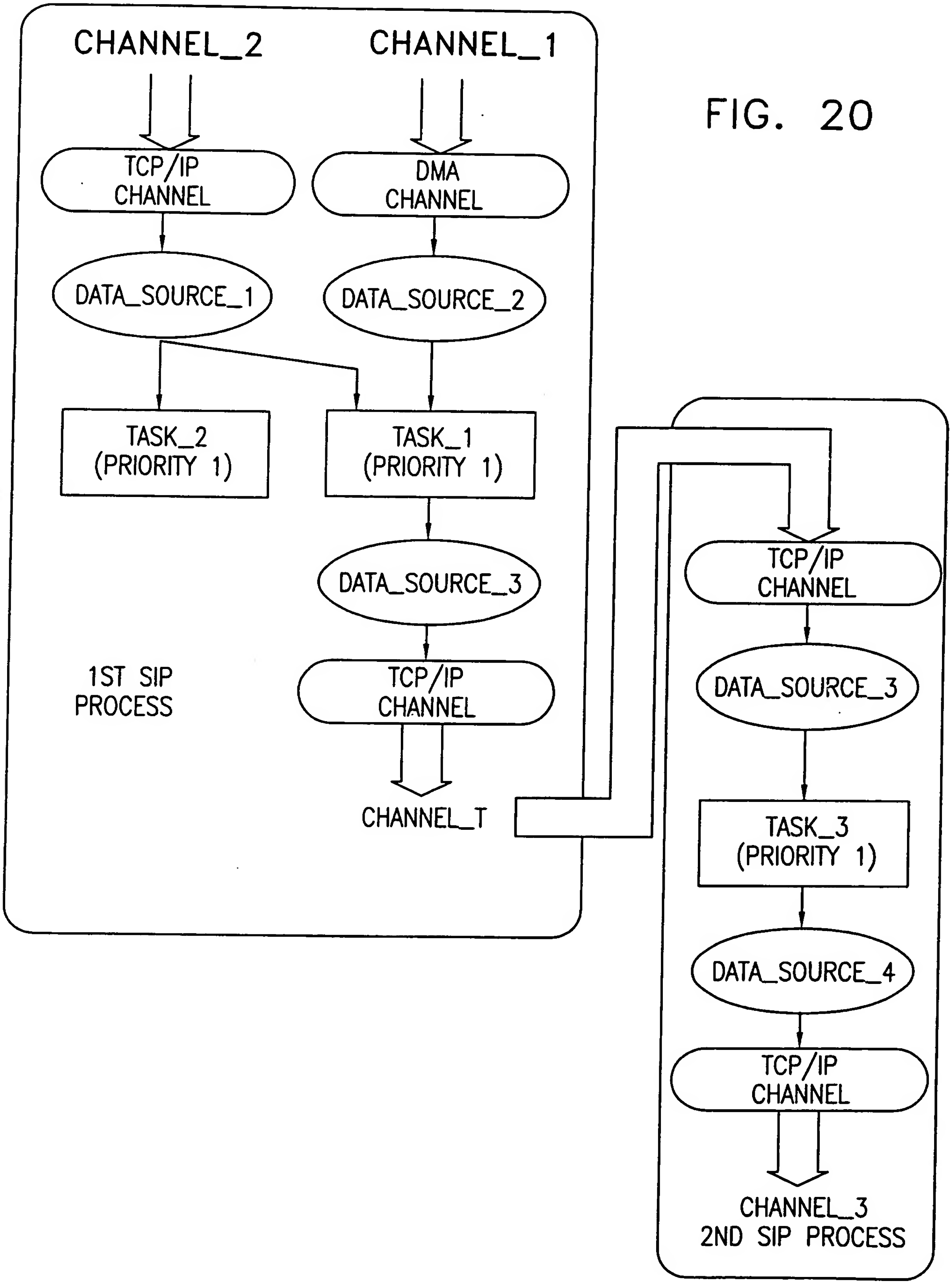

CHANNEL_2
CHANNEL_1
TCP/IP CHANNEL
DMA CHANNEL
DATA_SOURCE_1
DATA_SOURCE_2
TASK_2 (PRIORITY 1)
TASK_1 (PRIORITY 1)
DATA_SOURCE_3
1ST SIP PROCESS
TCP/IP CHANNEL
CHANNEL_T
TCP/IP CHANNEL
DATA_SOURCE_3
TASK_3 (PRIORITY 1)
DATA_SOURCE_4
TCP/IP CHANNEL
CHANNEL_3
2ND SIP PROCESS

FIG. 20

FIG. 21A

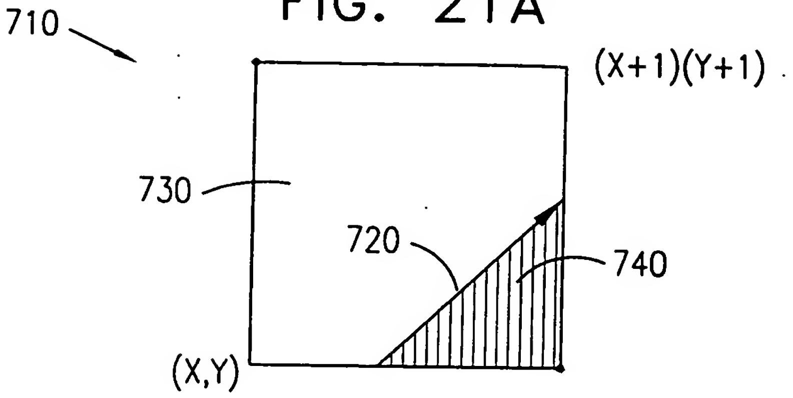


FIG. 21B

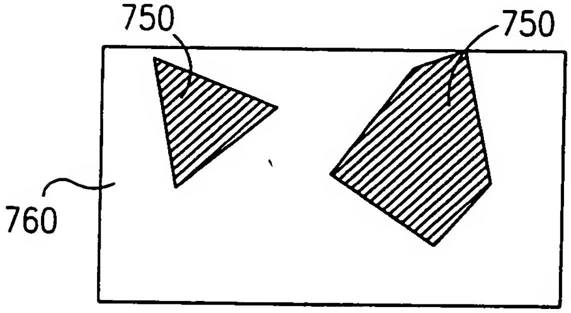


FIG. 21C

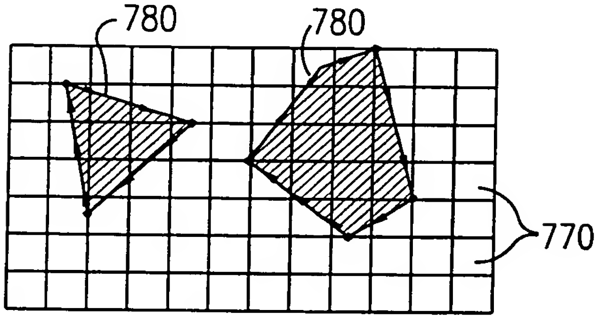


FIG. 21D

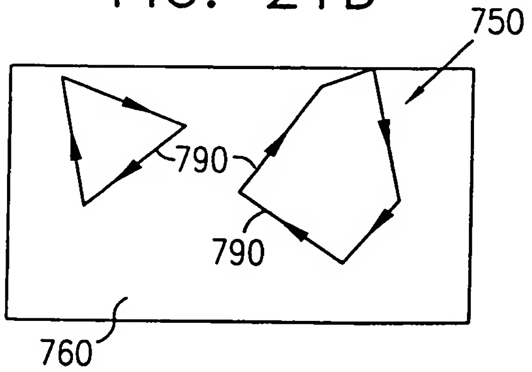


FIG. 22A

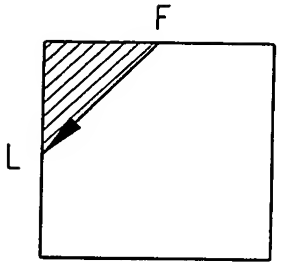


FIG. 22B

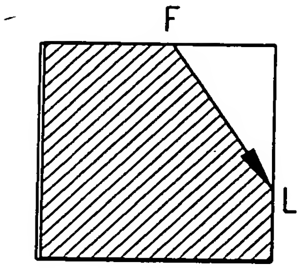


FIG. 22C

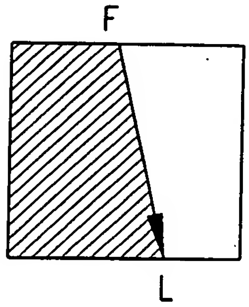


FIG. 22D

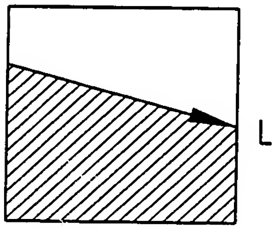


FIG. 22E

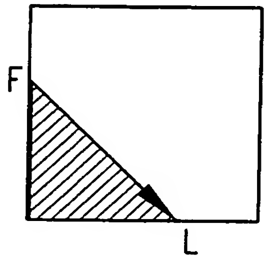


FIG. 22F

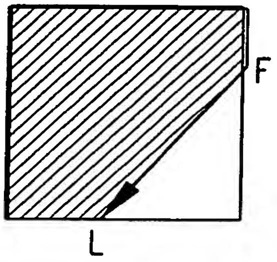


FIG. 22G

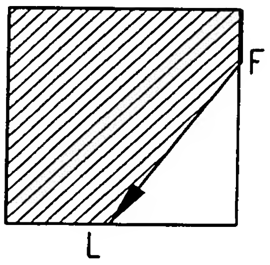


FIG. 22H

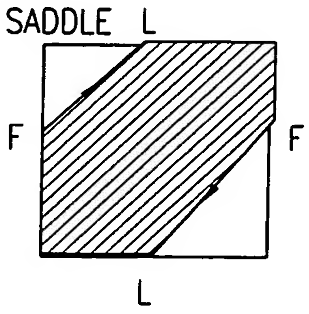


FIG. 23A

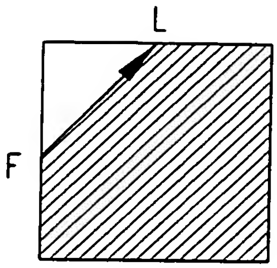


FIG. 23B

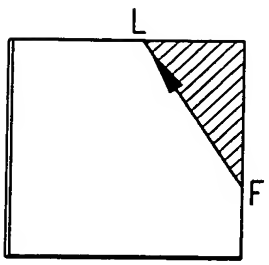


FIG. 23C

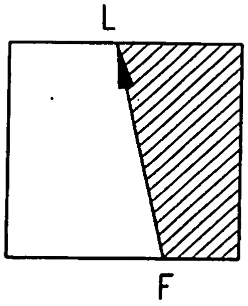


FIG. 23D

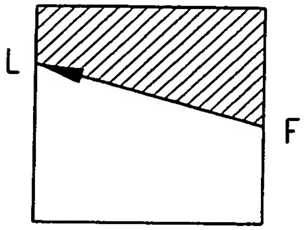


FIG. 23E

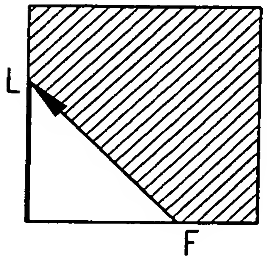


FIG. 23F

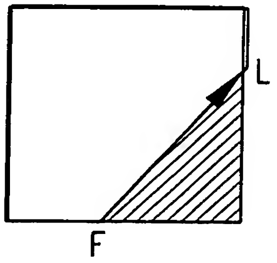


FIG. 23G

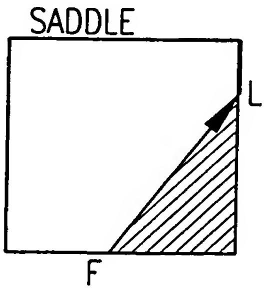


FIG. 23H

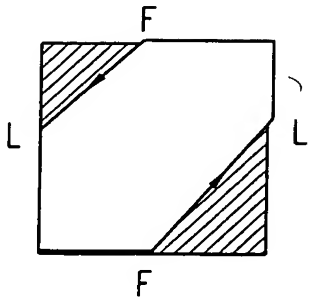


FIG. 231

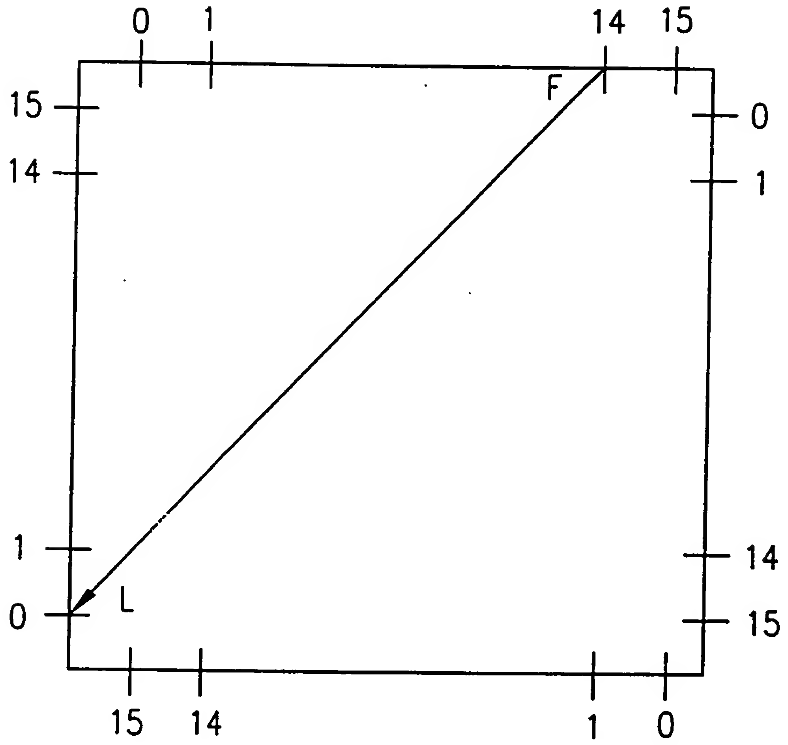
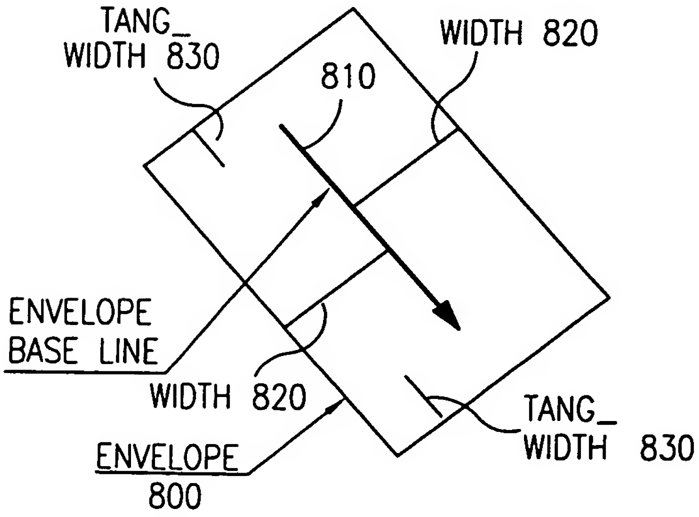


FIG. 24



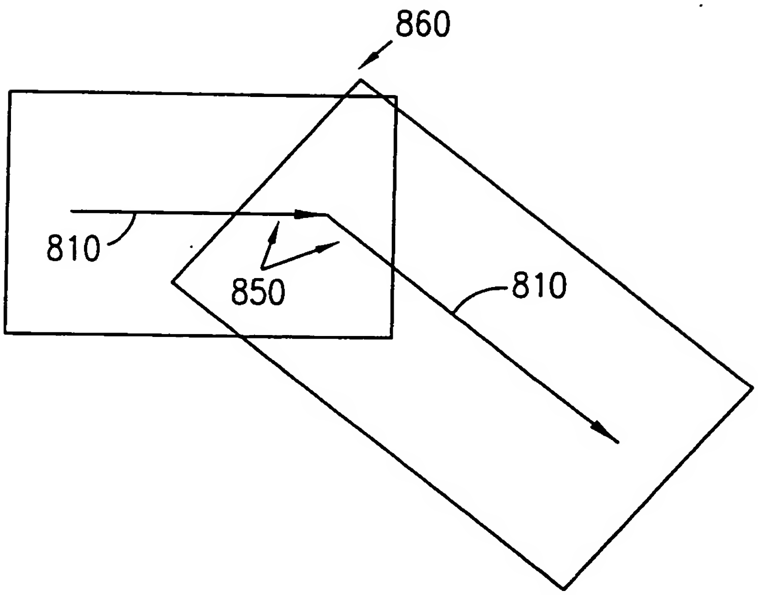


FIG. 25

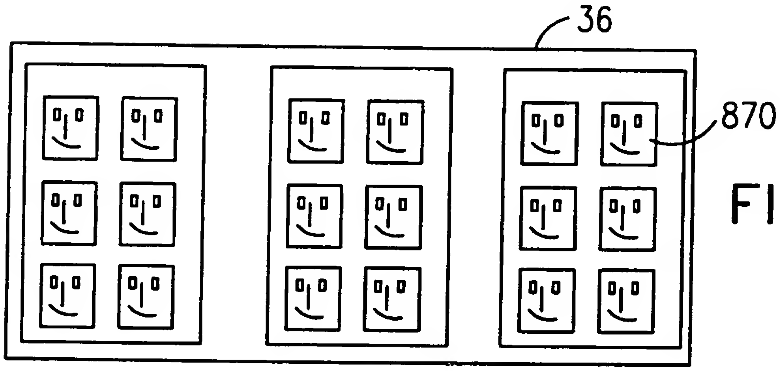


FIG. 26

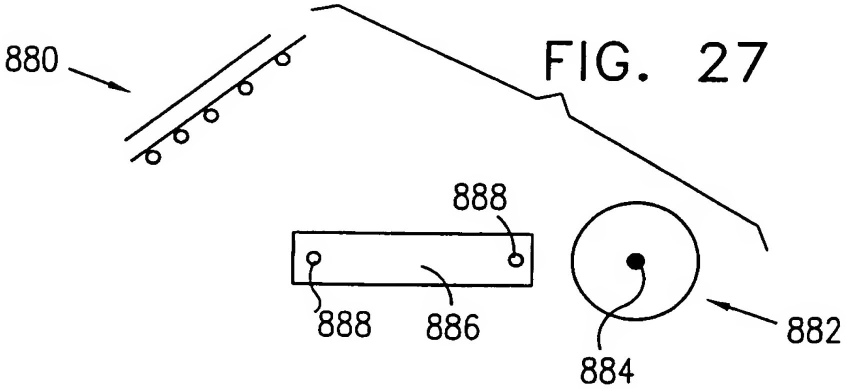


FIG. 27

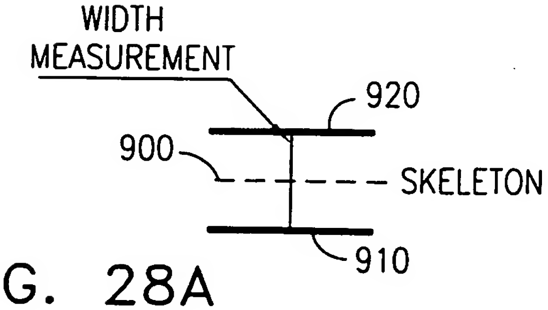


FIG. 28A

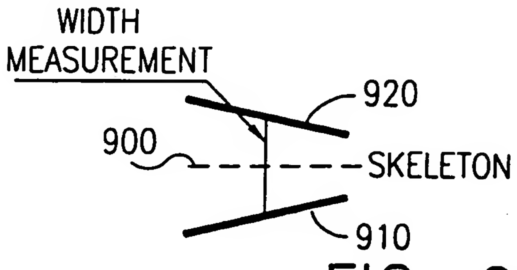
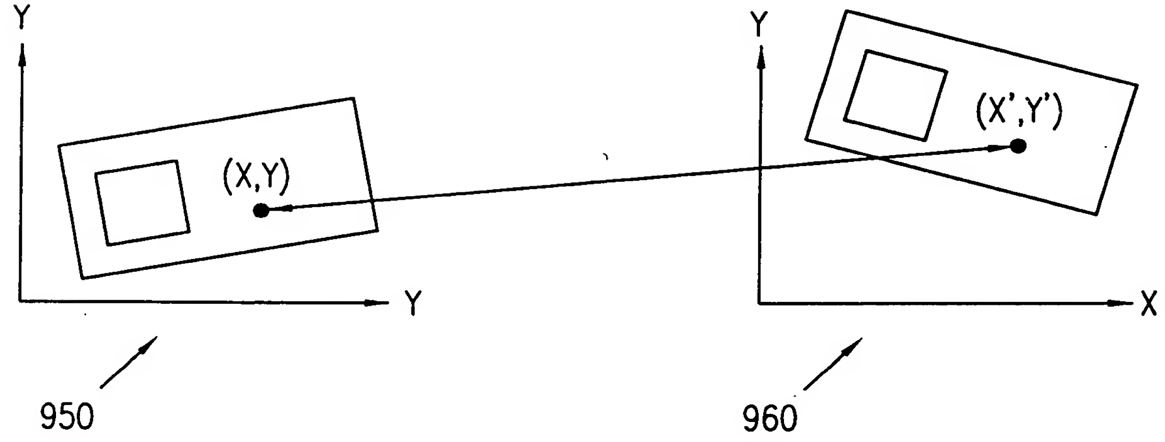


FIG. 28B

FIG. 29



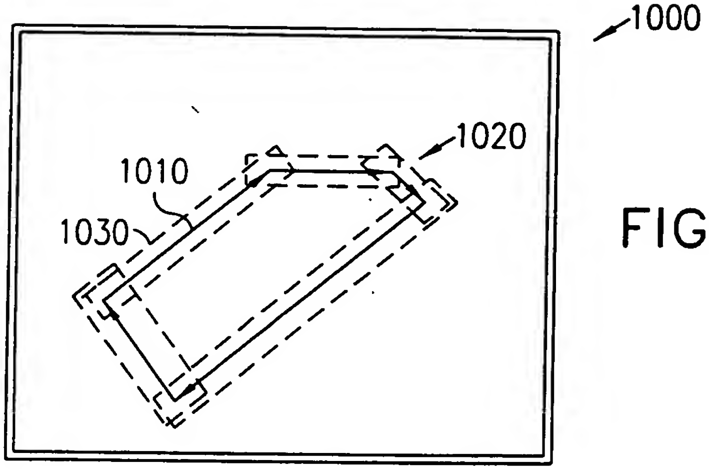


FIG. 30A

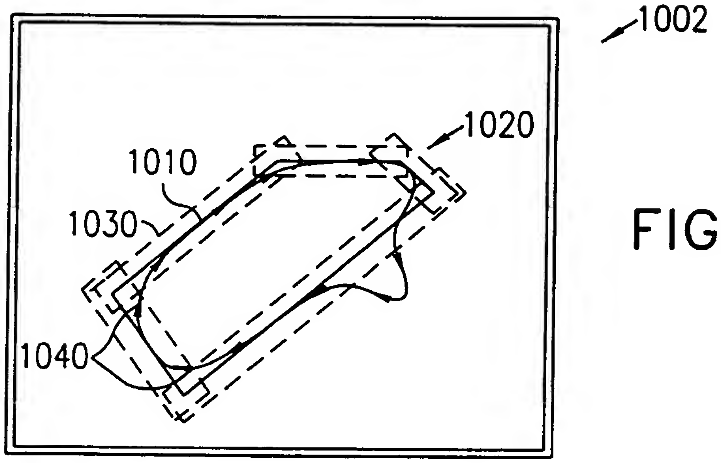


FIG. 30B

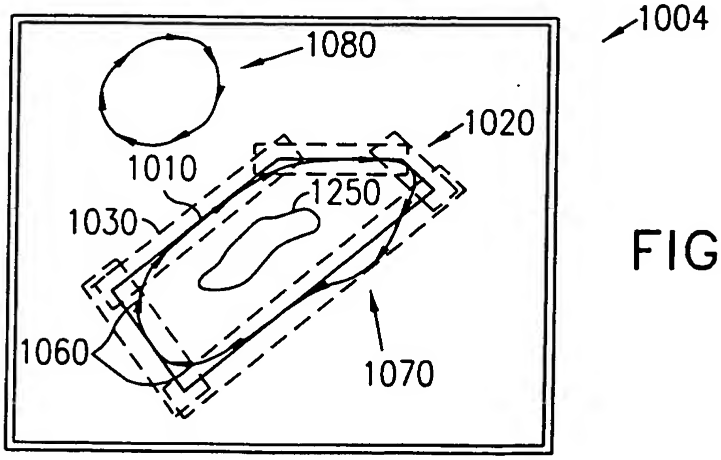


FIG. 30C

FIG. 31

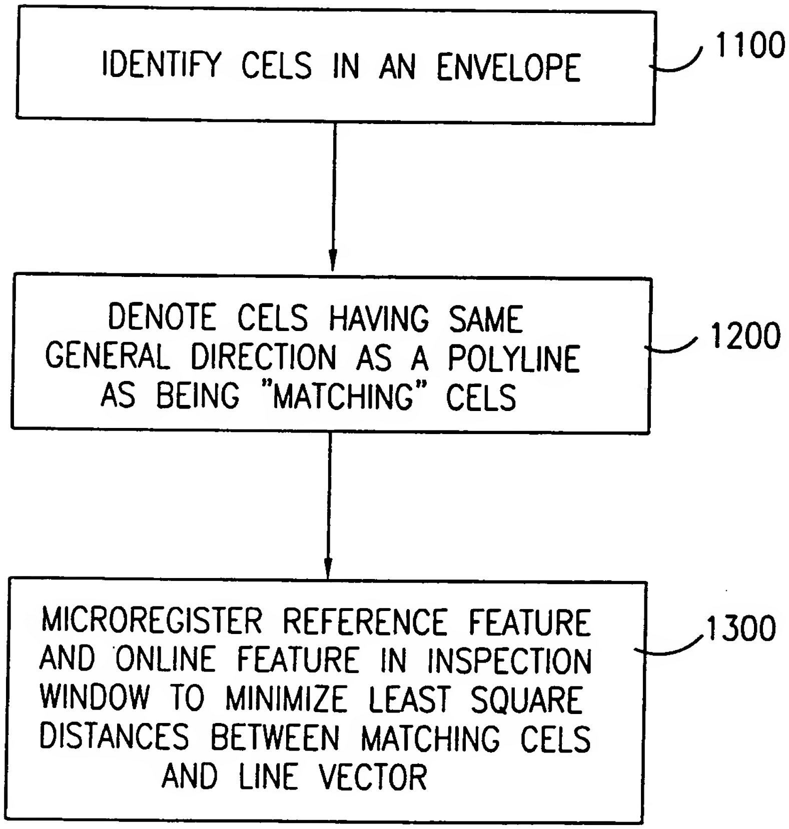

IDENTIFY CELS IN AN ENVELOPE
1100
DENOTE CELS HAVING SAME GENERAL DIRECTION AS A POLYLINE AS BEING "MATCHING" CELS
1200
MICROREGISTER REFERENCE FEATURE AND ONLINE FEATURE IN INSPECTION WINDOW TO MINIMIZE LEAST SQUARE DISTANCES BETWEEN MATCHING CELS AND LINE VECTOR
1300

FIG. 32A

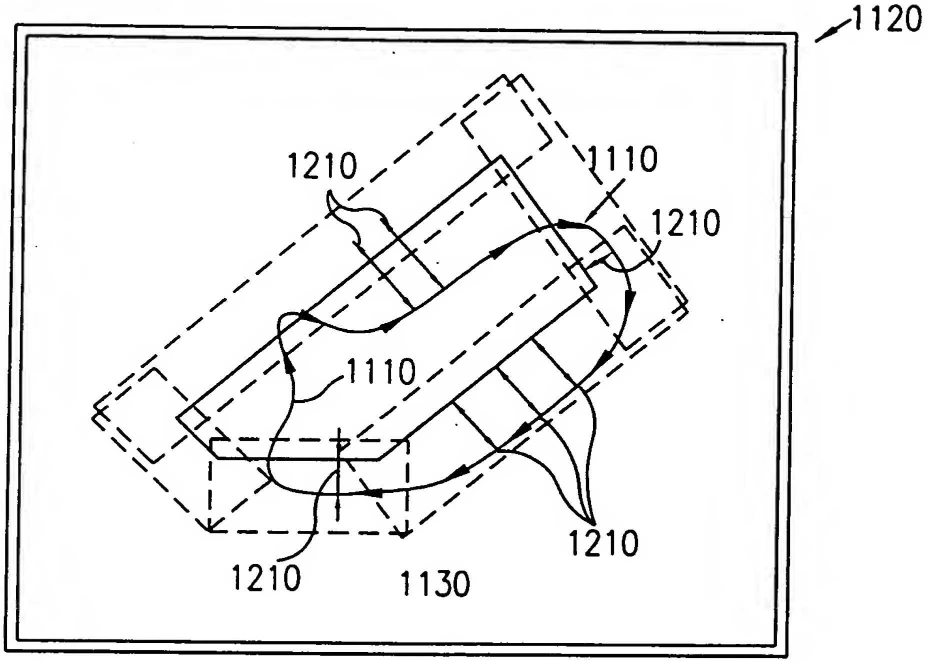


FIG. 32B

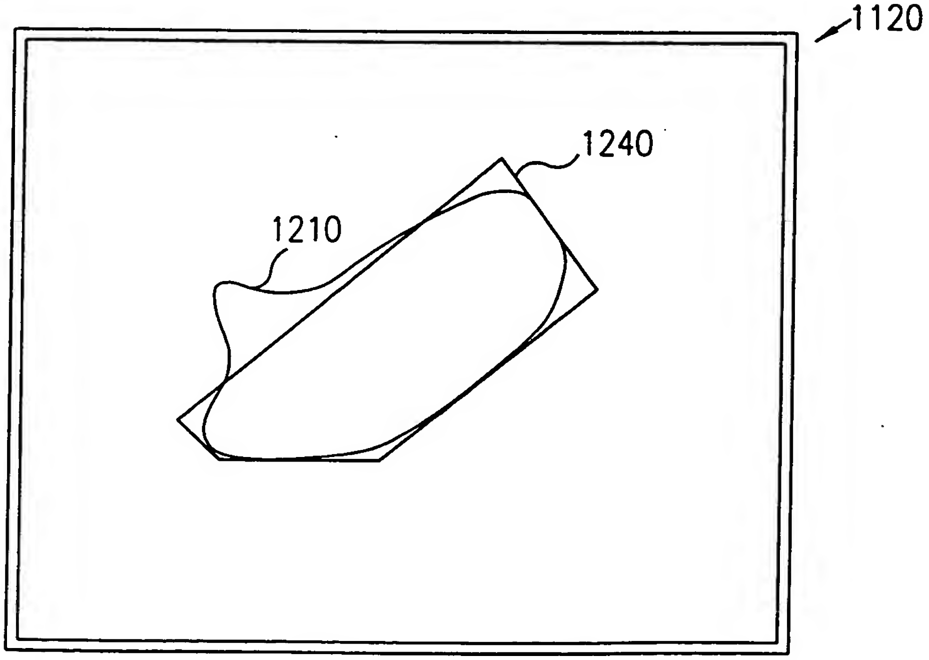
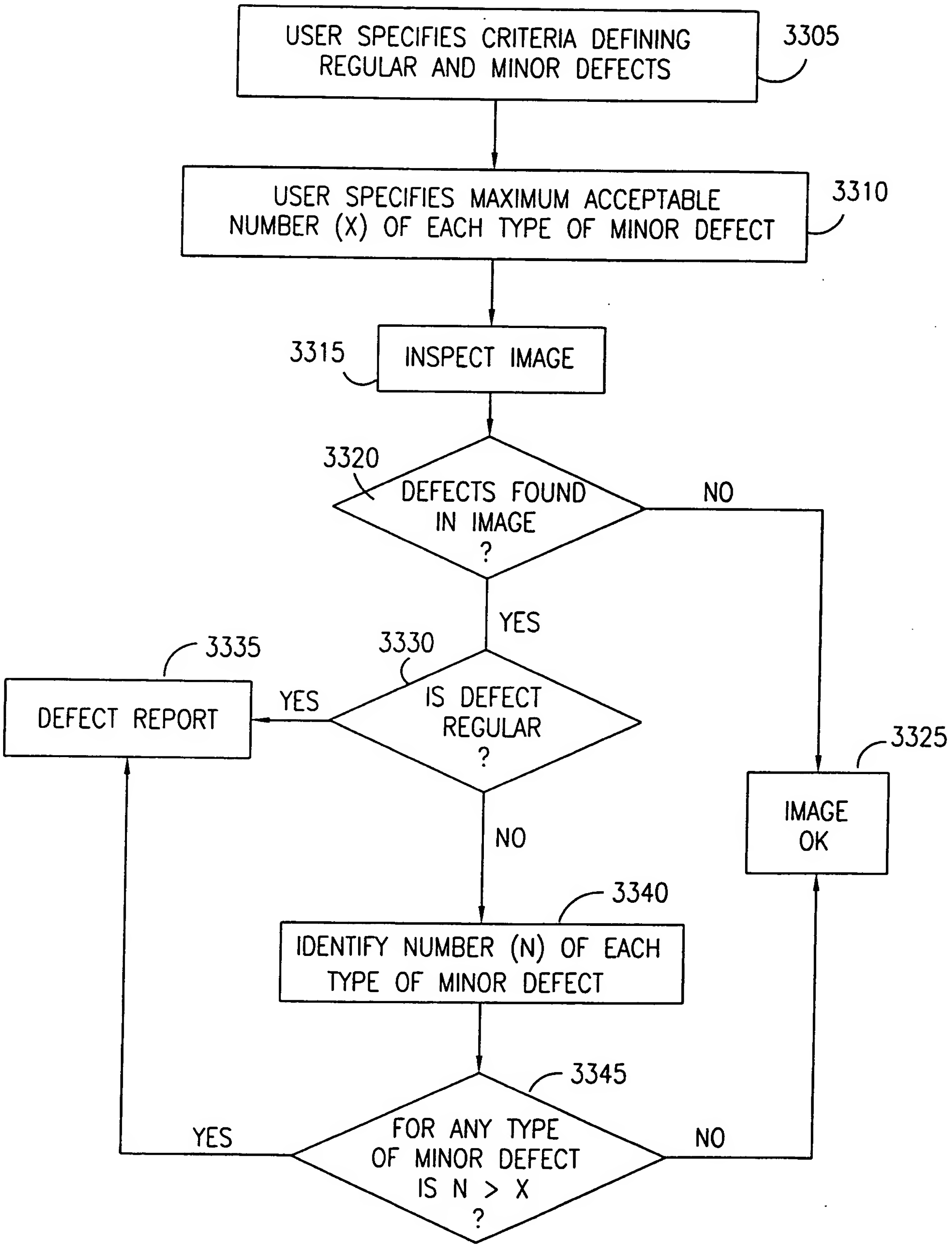
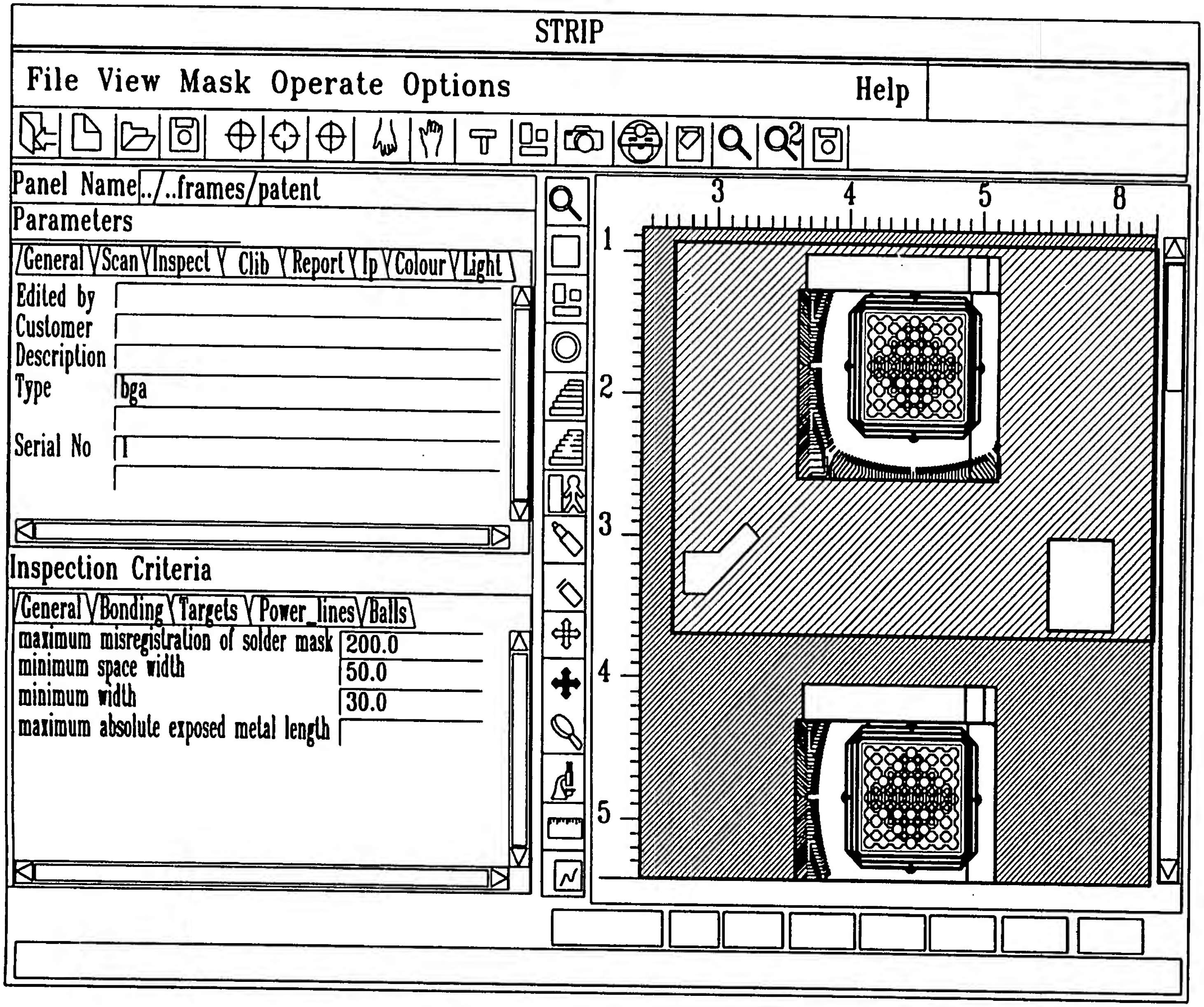


FIG. 33


USER SPECIFIES CRITERIA DEFINING REGULAR AND MINOR DEFECTS
3305
USER SPECIFIES MAXIMUM ACCEPTABLE NUMBER (X) OF EACH TYPE OF MINOR DEFECT
3310
3315
INSPECT IMAGE
3320
DEFECTS FOUND IN IMAGE ?
NO
YES
3335
3330
DEFECT REPORT
YES
IS DEFECT REGULAR ?
3325
IMAGE OK
NO
3340
IDENTIFY NUMBER (N) OF EACH TYPE OF MINOR DEFECT
3345
YES
FOR ANY TYPE OF MINOR DEFECT IS N > X ?
NO



Panel Name ../..frames/patent

Edited by

Customer

Description

Type bga

Serial No 1

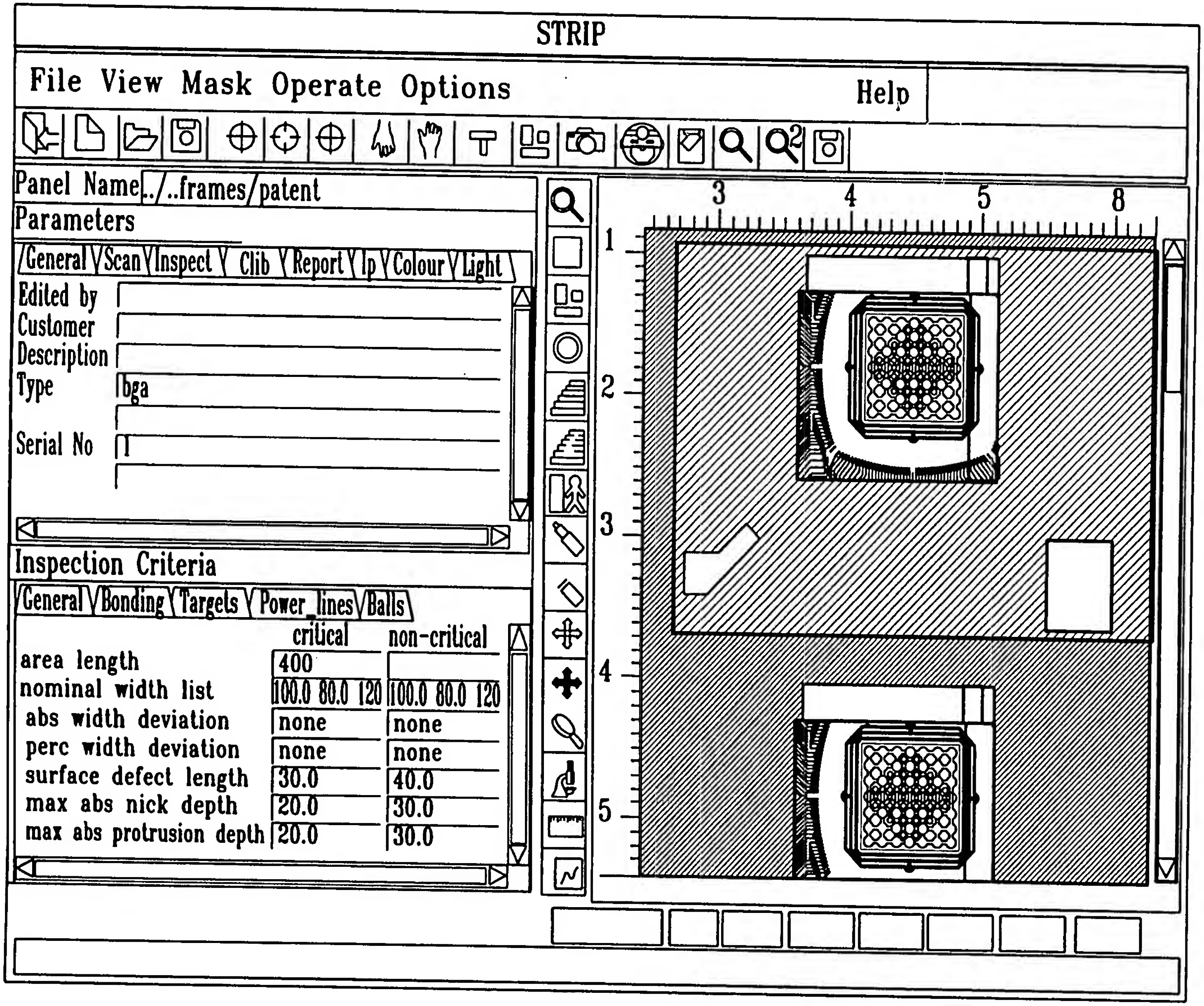
maximum misregistration of solder mask 200.0

minimum space width 50.0

minimum width 30.0

maximum absolute exposed metal length

FIG. 34



Panel Name ../..frames/patent

Parameters

/General\/Scan\/Inspect\/ Clib \/Report\/Ip\/Colour\/Light\

Edited by

Customer

Description

Type bga

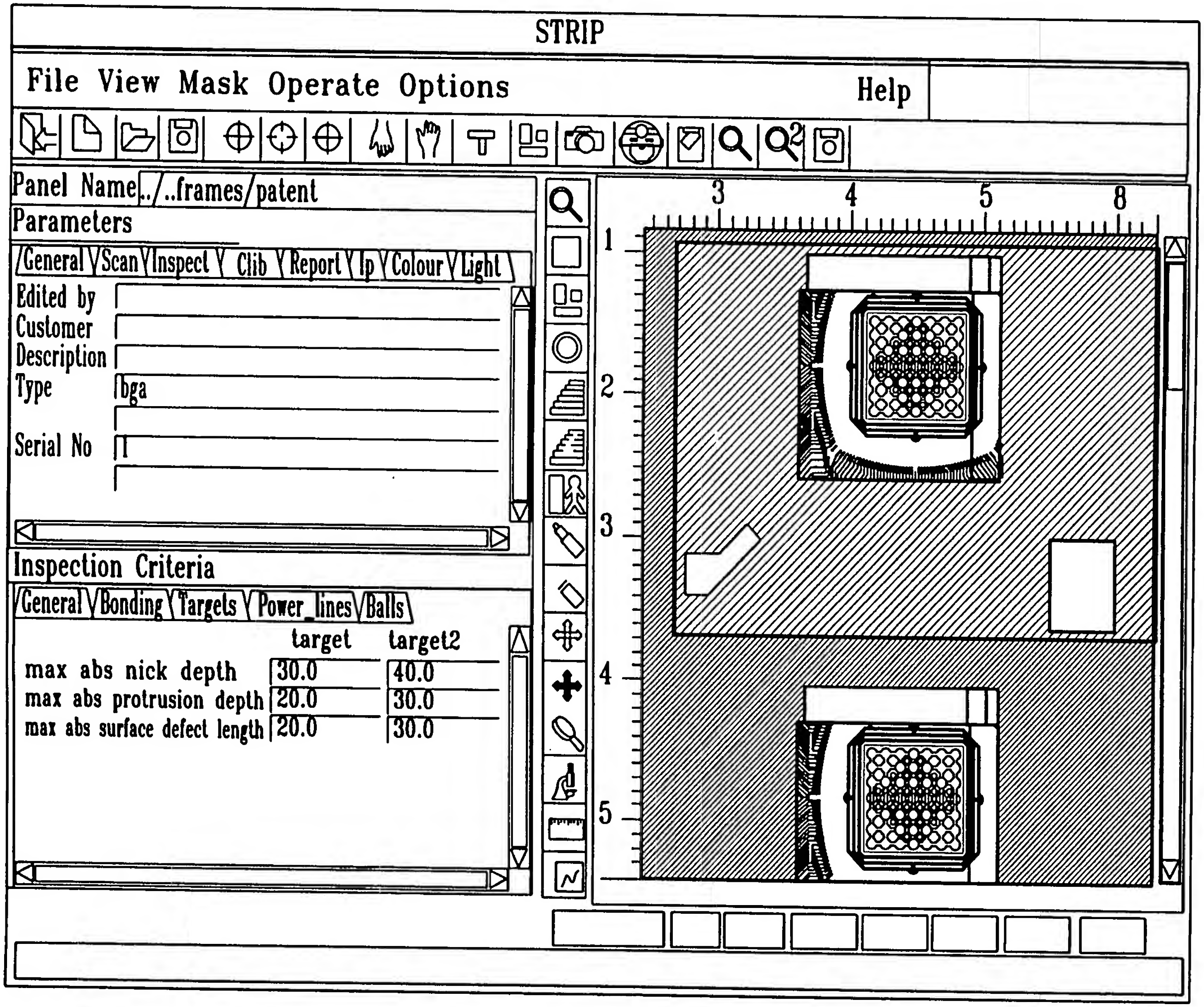
Serial No 1

Inspection Criteria

/General\/Bonding\/Targets\/Power_lines\/Balls\

	critical	non-critical
area length	400	
nominal width list	100.0 80.0 120	100.0 80.0 120
abs width deviation	none	none
perc width deviation	none	none
surface defect length	30.0	40.0
max abs nick depth	20.0	30.0
max abs protrusion depth	20.0	30.0

FIG. 35



Panel Name ../..frames/patent

Parameters

General | Scan | Inspect | Clib | Report | Ip | Colour | Light

Edited by

Customer

Description

Type bga

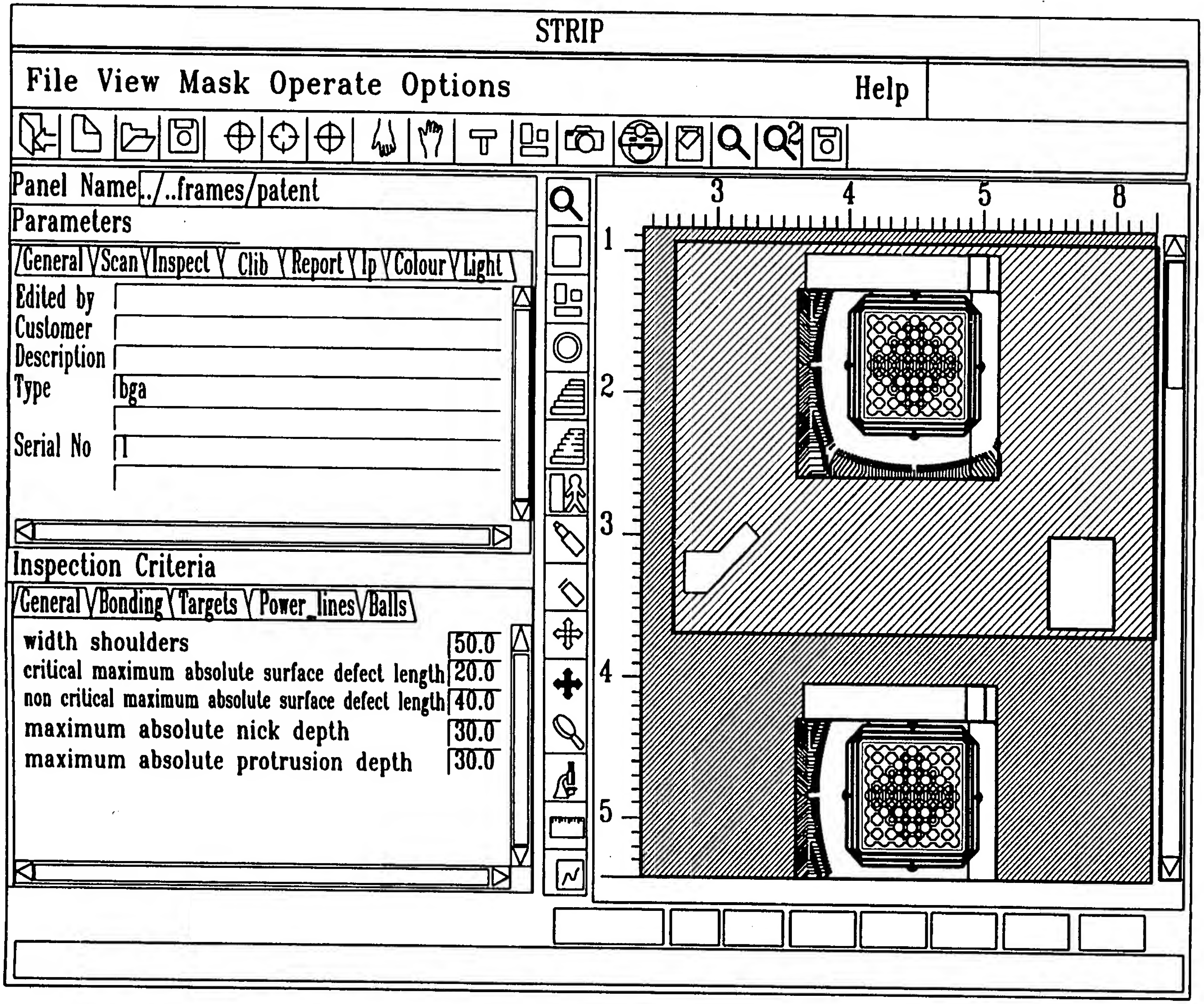
Serial No 1

Inspection Criteria

General | Bonding | Targets | Power_lines | Balls

	target	target2
max abs nick depth	30.0	40.0
max abs protrusion depth	20.0	30.0
max abs surface defect length	20.0	30.0

FIG. 36

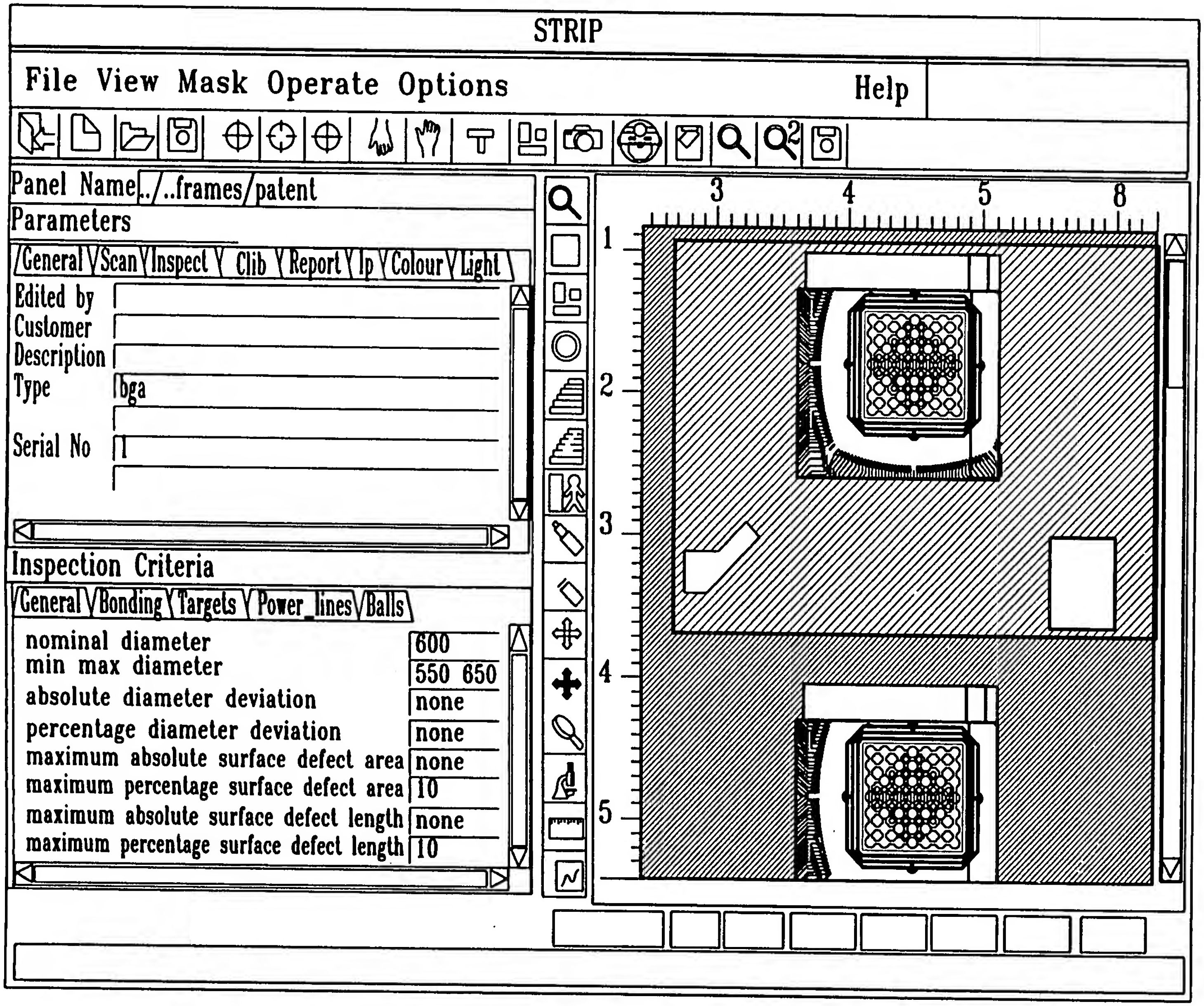

STRIP
File View Mask Operate Options
Help
Parameters
/General\/Scan\/Inspect\/Clib\/Report\/Ip\/Colour\/Light\
Inspection Criteria
/General\/Bonding\/Targets\/Power_lines\/Balls\
3
4
5
8
1
2
3
4
5

Panel Name ../..frames/patent

Edited by
Customer
Description
Type bga
Serial No 1

width shoulders 50.0
critical maximum absolute surface defect length 20.0
non critical maximum absolute surface defect length 40.0
maximum absolute nick depth 30.0
maximum absolute protrusion depth 30.0

FIG. 37



Panel Name ../..frames/patent

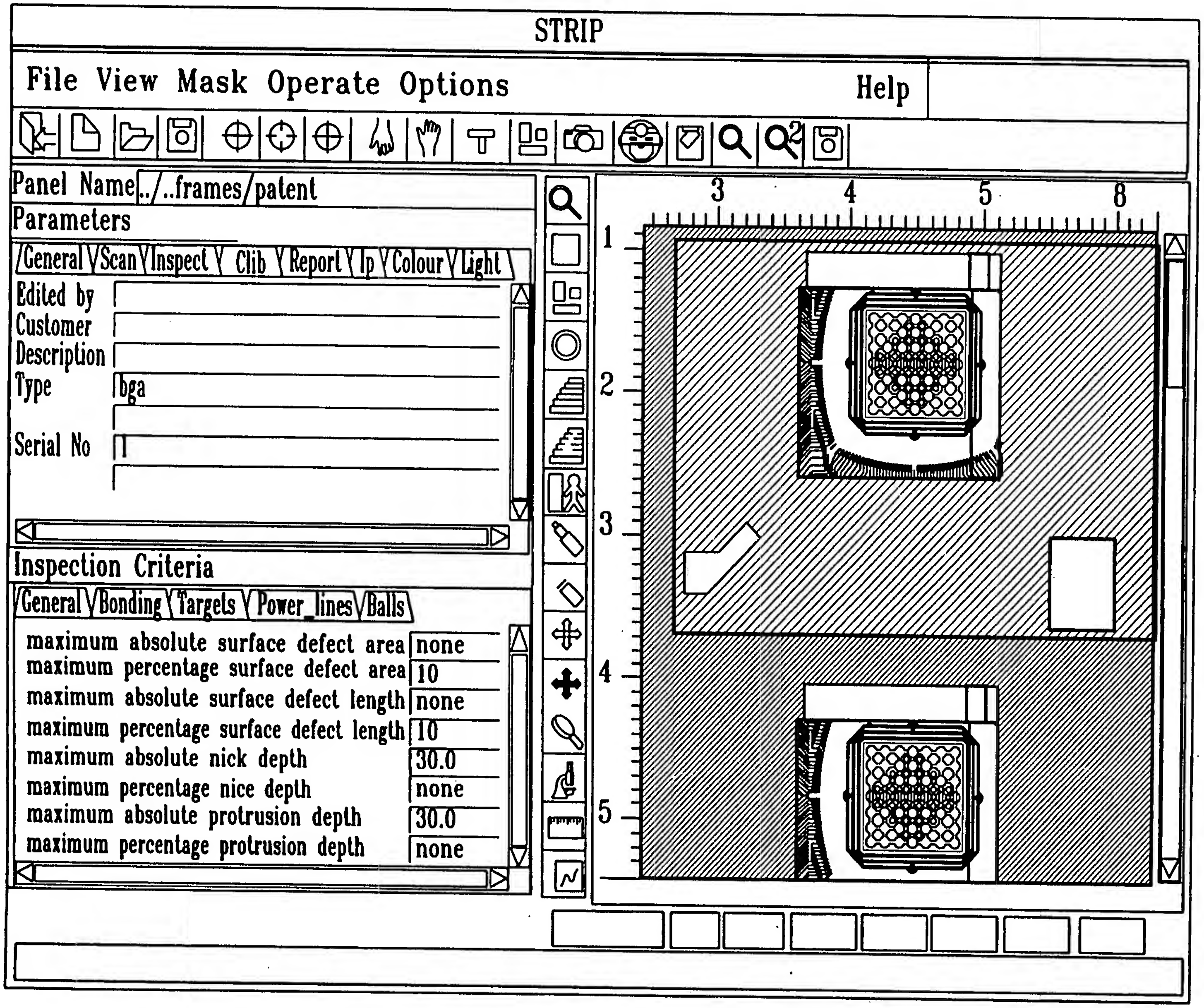
Parameters

Edited by
Customer
Description
Type bga
Serial No 1

Inspection Criteria

nominal diameter	600
min max diameter	550 650
absolute diameter deviation	none
percentage diameter deviation	none
maximum absolute surface defect area	none
maximum percentage surface defect area	10
maximum absolute surface defect length	none
maximum percentage surface defect length	10

FIG. 38



Panel Name ../..frames/patent

Parameters

/General \/Scan \/Inspect \/ Clib \/ Report \/ Ip \/ Colour \/ Light \

Edited by	
Customer	
Description	
Type	bga
Serial No	

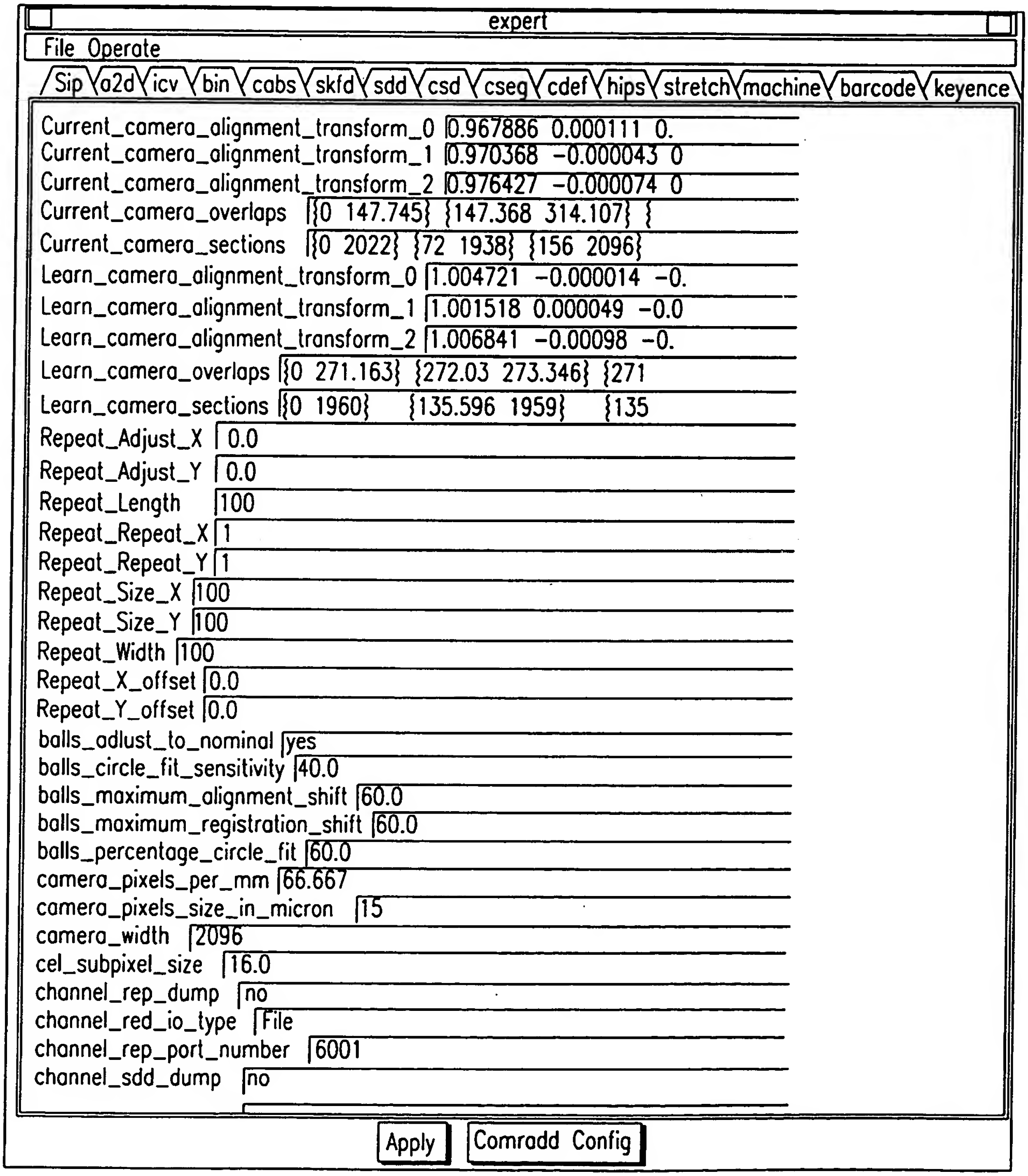
Inspection Criteria

/General \/Bonding \/Targets \/ Power_lines \/Balls \

maximum absolute surface defect area	none
maximum percentage surface defect area	10
maximum absolute surface defect length	none
maximum percentage surface defect length	10
maximum absolute nick depth	30.0
maximum percentage nice depth	none
maximum absolute protrusion depth	30.0
maximum percentage protrusion depth	none

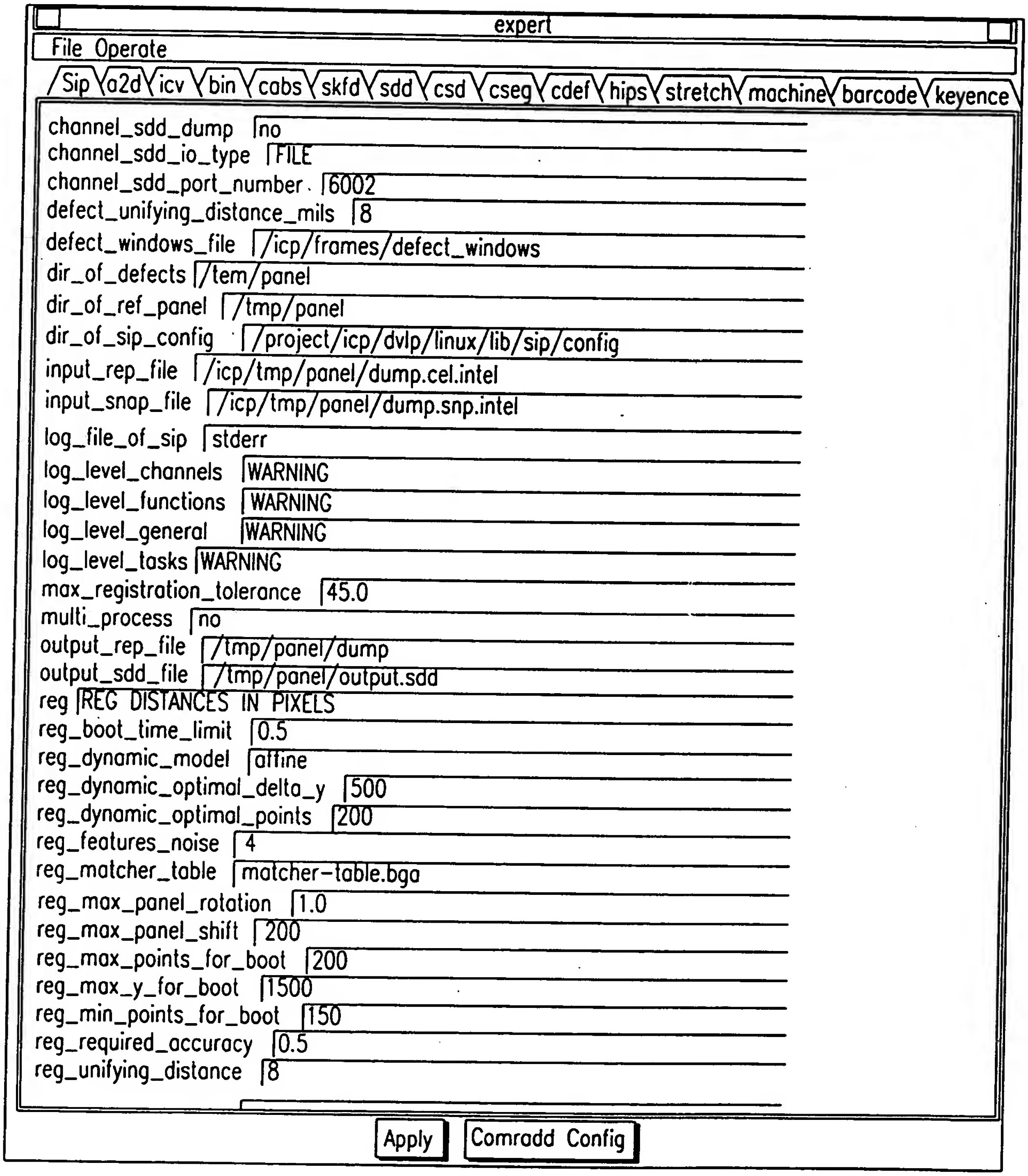
FIG. 39

FIG. 40



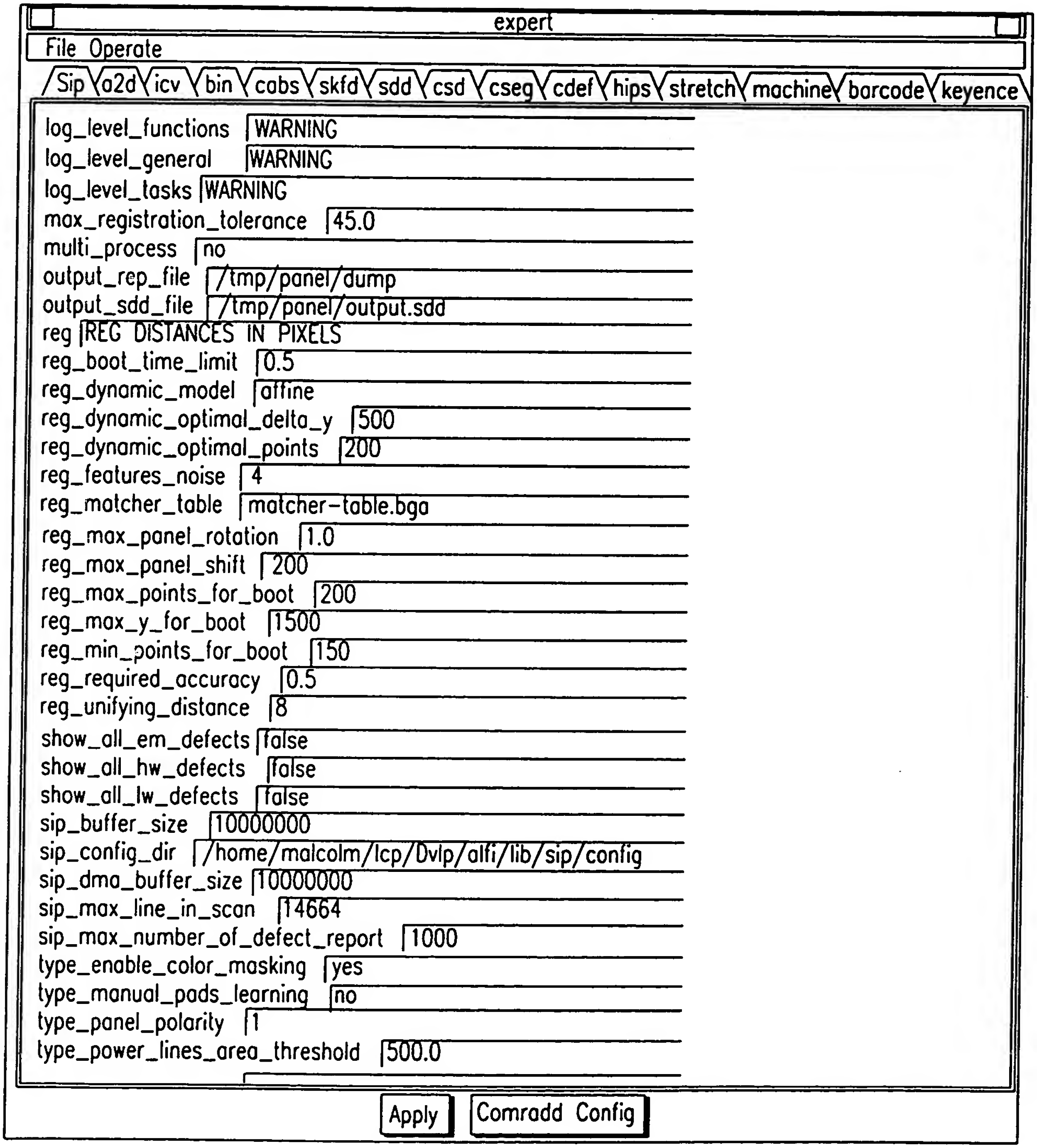
Current_camera_alignment_transform_0 0.967886 0.000111 0.
Current_camera_alignment_transform_1 0.970368 -0.000043 0
Current_camera_alignment_transform_2 0.976427 -0.000074 0
Current_camera_overlaps {0 147.745} {147.368 314.107} {
Current_camera_sections {0 2022} {72 1938} {156 2096}
Learn_camera_alignment_transform_0 1.004721 -0.000014 -0.
Learn_camera_alignment_transform_1 1.001518 0.000049 -0.0
Learn_camera_alignment_transform_2 1.006841 -0.00098 -0.
Learn_camera_overlaps {0 271.163} {272.03 273.346} {271
Learn_camera_sections {0 1960} {135.596 1959} {135
Repeat_Adjust_X 0.0
Repeat_Adjust_Y 0.0
Repeat_Length 100
Repeat_Repeat_X 1
Repeat_Repeat_Y 1
Repeat_Size_X 100
Repeat_Size_Y 100
Repeat_Width 100
Repeat_X_offset 0.0
Repeat_Y_offset 0.0
balls_adlust_to_nominal yes
balls_circle_fit_sensitivity 40.0
balls_maximum_alignment_shift 60.0
balls_maximum_registration_shift 60.0
balls_percentage_circle_fit 60.0
camera_pixels_per_mm 66.667
camera_pixels_size_in_micron 15
camera_width 2096
cel_subpixel_size 16.0
channel_rep_dump no
channel_red_io_type File
channel_rep_port_number 6001
channel_sdd_dump no

FIG. 41



```
channel_sdd_dump          no
channel_sdd_io_type       FILE
channel_sdd_port_number   6002
defect_unifying_distance_mils 8
defect_windows_file       /icp/frames/defect_windows
dir_of_defects            /tem/panel
dir_of_ref_panel          /tmp/panel
dir_of_sip_config         /project/icp/dvlp/linux/lib/sip/config
input_rep_file            /icp/tmp/panel/dump.cel.intel
input_snap_file           /icp/tmp/panel/dump.snp.intel
log_file_of_sip           stderr
log_level_channels        WARNING
log_level_functions       WARNING
log_level_general         WARNING
log_level_tasks           WARNING
max_registration_tolerance 45.0
multi_process             no
output_rep_file           /tmp/panel/dump
output_sdd_file           /tmp/panel/output.sdd
reg                       REG DISTANCES IN PIXELS
reg_boot_time_limit       0.5
reg_dynamic_model         affine
reg_dynamic_optimal_delta_y 500
reg_dynamic_optimal_points 200
reg_features_noise        4
reg_matcher_table         matcher-table.bga
reg_max_panel_rotation    1.0
reg_max_panel_shift       200
reg_max_points_for_boot   200
reg_max_y_for_boot        1500
reg_min_points_for_boot   150
reg_required_accuracy     0.5
reg_unifying_distance     8
```

FIG. 42



log_level_functions WARNING
log_level_general WARNING
log_level_tasks WARNING
max_registration_tolerance 45.0
multi_process no
output_rep_file /tmp/panel/dump
output_sdd_file /tmp/panel/output.sdd
reg REG DISTANCES IN PIXELS
reg_boot_time_limit 0.5
reg_dynamic_model affine
reg_dynamic_optimal_delta_y 500
reg_dynamic_optimal_points 200
reg_features_noise 4
reg_matcher_table matcher-table.bga
reg_max_panel_rotation 1.0
reg_max_panel_shift 200
reg_max_points_for_boot 200
reg_max_y_for_boot 1500
reg_min_points_for_boot 150
reg_required_accuracy 0.5
reg_unifying_distance 8
show_all_em_defects false
show_all_hw_defects false
show_all_lw_defects false
sip_buffer_size 10000000
sip_config_dir /home/malcolm/lcp/Dvlp/alfi/lib/sip/config
sip_dma_buffer_size 10000000
sip_max_line_in_scan 14664
sip_max_number_of_defect_report 1000
type_enable_color_masking yes
type_manual_pads_learning no
type_panel_polarity 1
type_power_lines_area_threshold 500.0

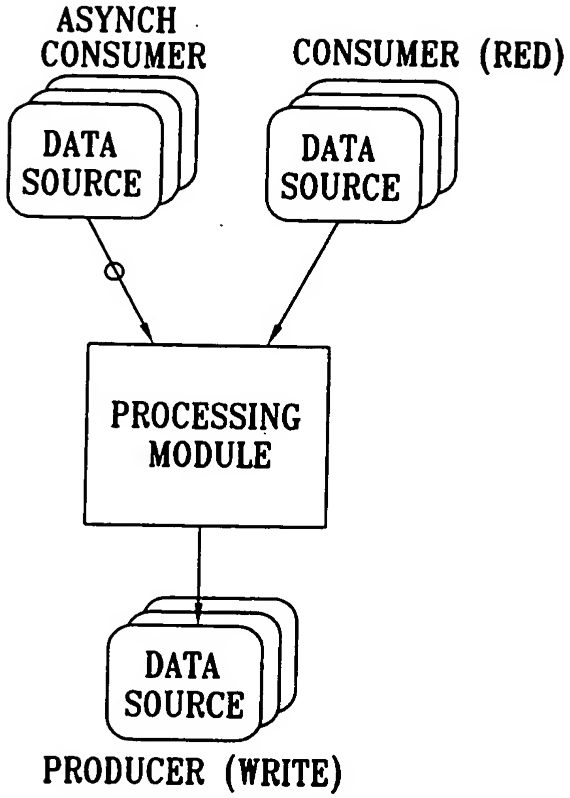

ASYNCH CONSUMER
DATA SOURCE
CONSUMER (RED)
DATA SOURCE
PROCESSING MODULE
DATA SOURCE
PRODUCER (WRITE)

FIG. 43

FIG. 44

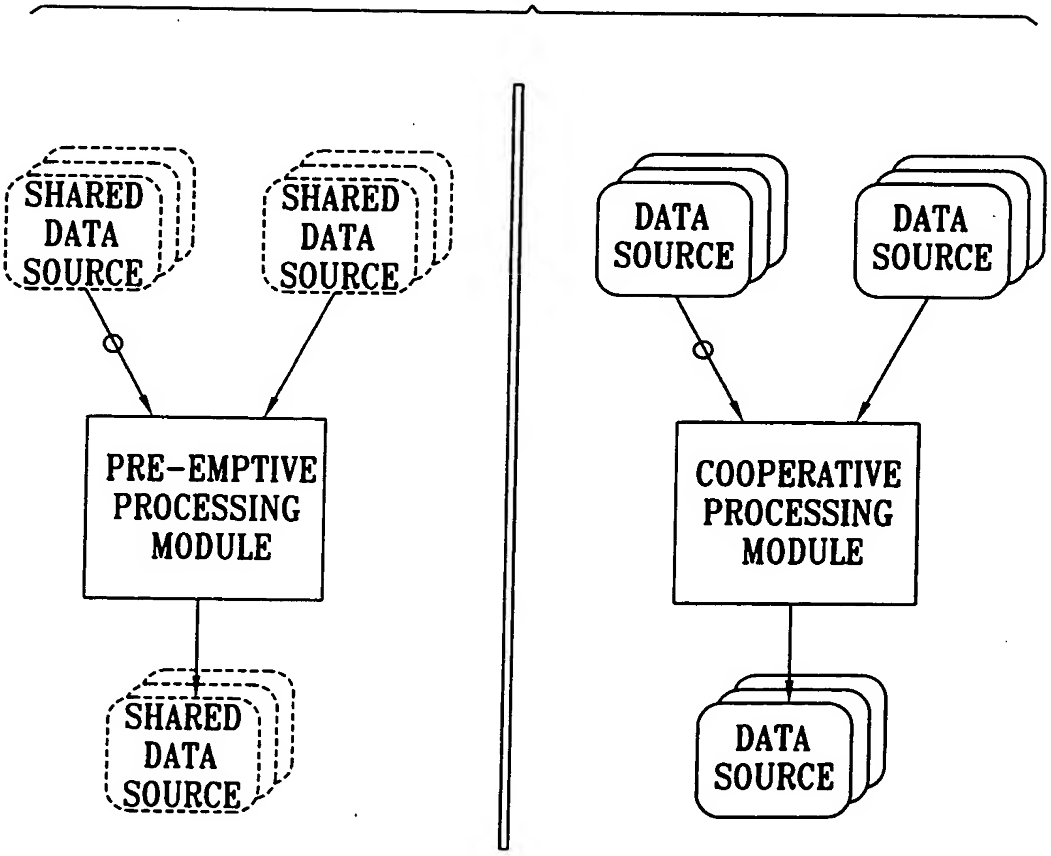
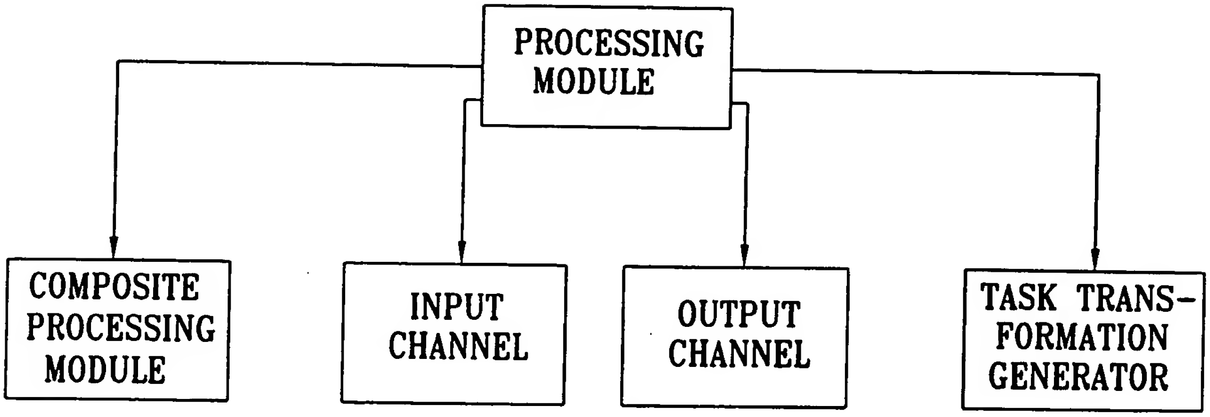

SHARED DATA SOURCE
SHARED DATA SOURCE
PRE-EMPTIVE PROCESSING MODULE
SHARED DATA SOURCE
DATA SOURCE
DATA SOURCE
COOPERATIVE PROCESSING MODULE
DATA SOURCE

FIG. 45


PROCESSING MODULE
COMPOSITE PROCESSING MODULE
INPUT CHANNEL
OUTPUT CHANNEL
TASK TRANSFORMATION GENERATOR

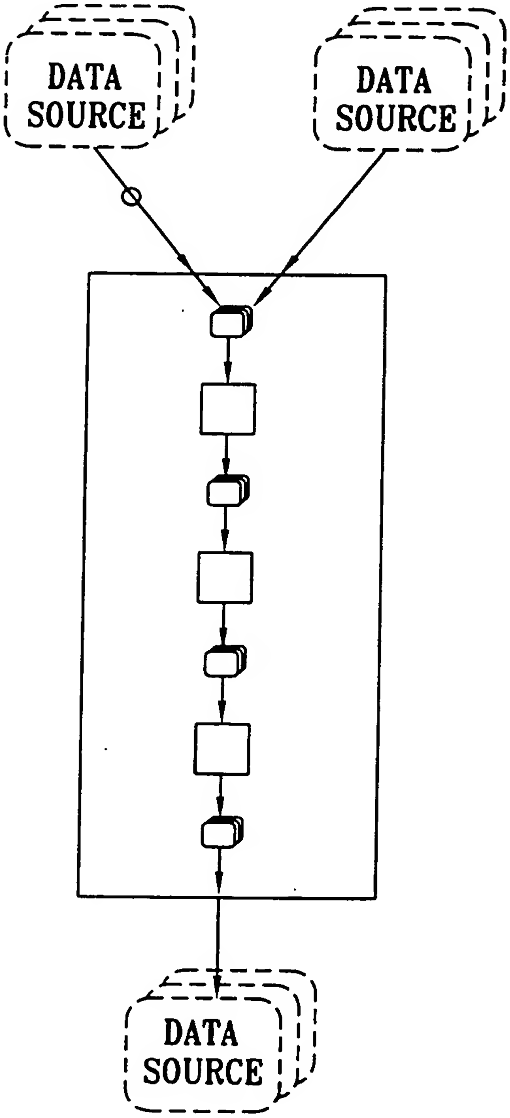

DATA SOURCE
DATA SOURCE
DATA SOURCE

FIG. 46

FIG. 47

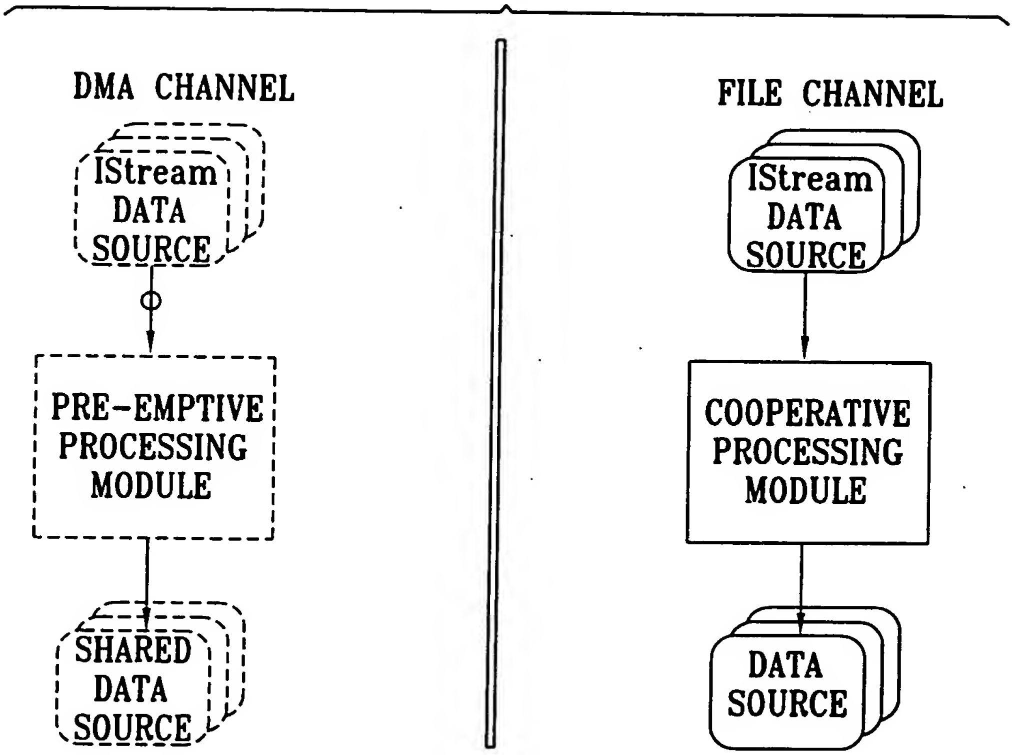

DMA CHANNEL
IStream DATA SOURCE
PRE-EMPTIVE PROCESSING MODULE
SHARED DATA SOURCE
FILE CHANNEL
IStream DATA SOURCE
COOPERATIVE PROCESSING MODULE
DATA SOURCE

FIG. 48

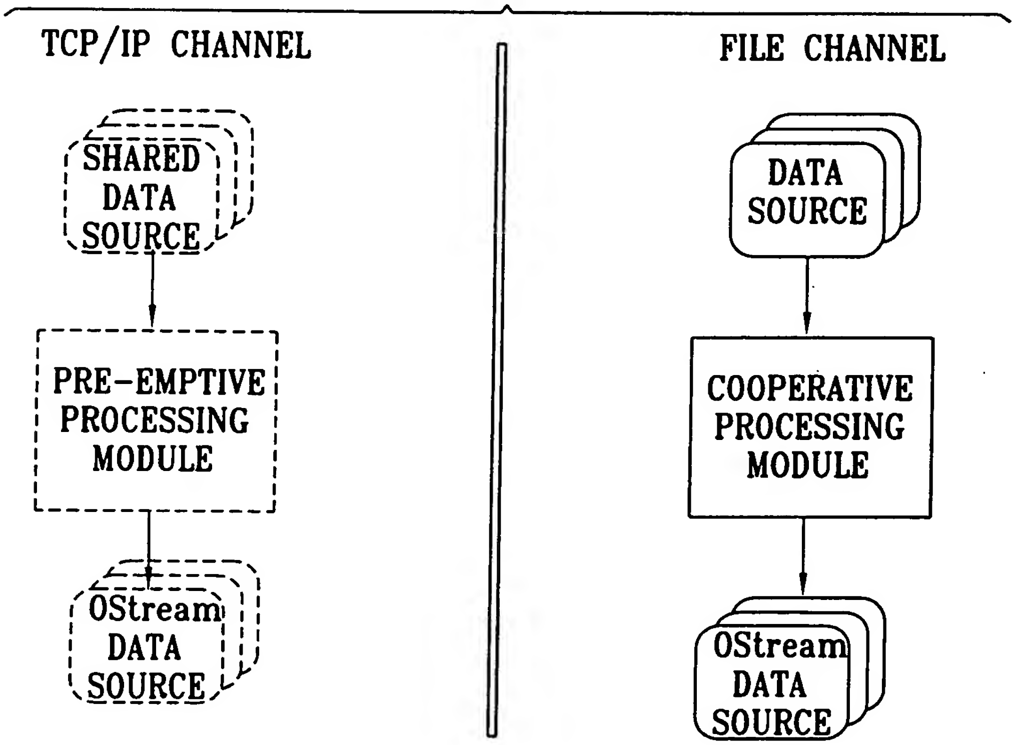

TCP/IP CHANNEL
SHARED DATA SOURCE
PRE-EMPTIVE PROCESSING MODULE
OStream DATA SOURCE
FILE CHANNEL
DATA SOURCE
COOPERATIVE PROCESSING MODULE
OStream DATA SOURCE

FIG. 49

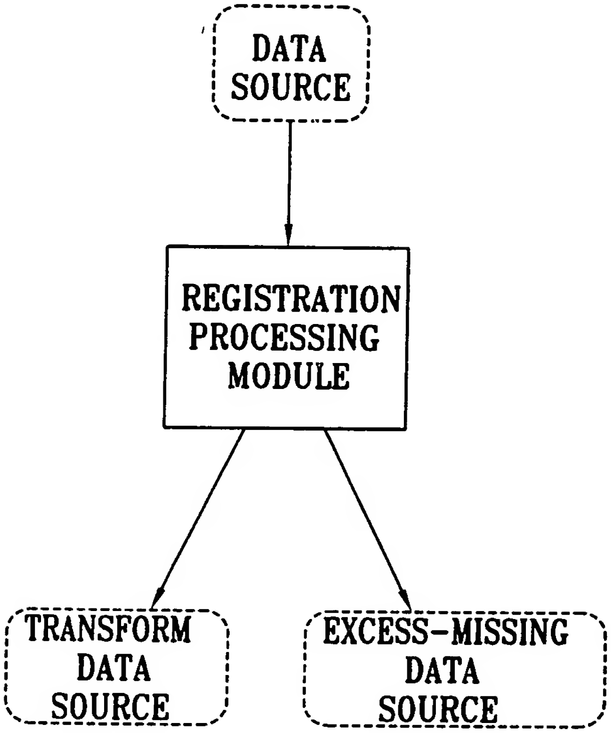

DATA SOURCE
REGISTRATION PROCESSING MODULE
TRANSFORM DATA SOURCE
EXCESS-MISSING DATA SOURCE

FIG. 50

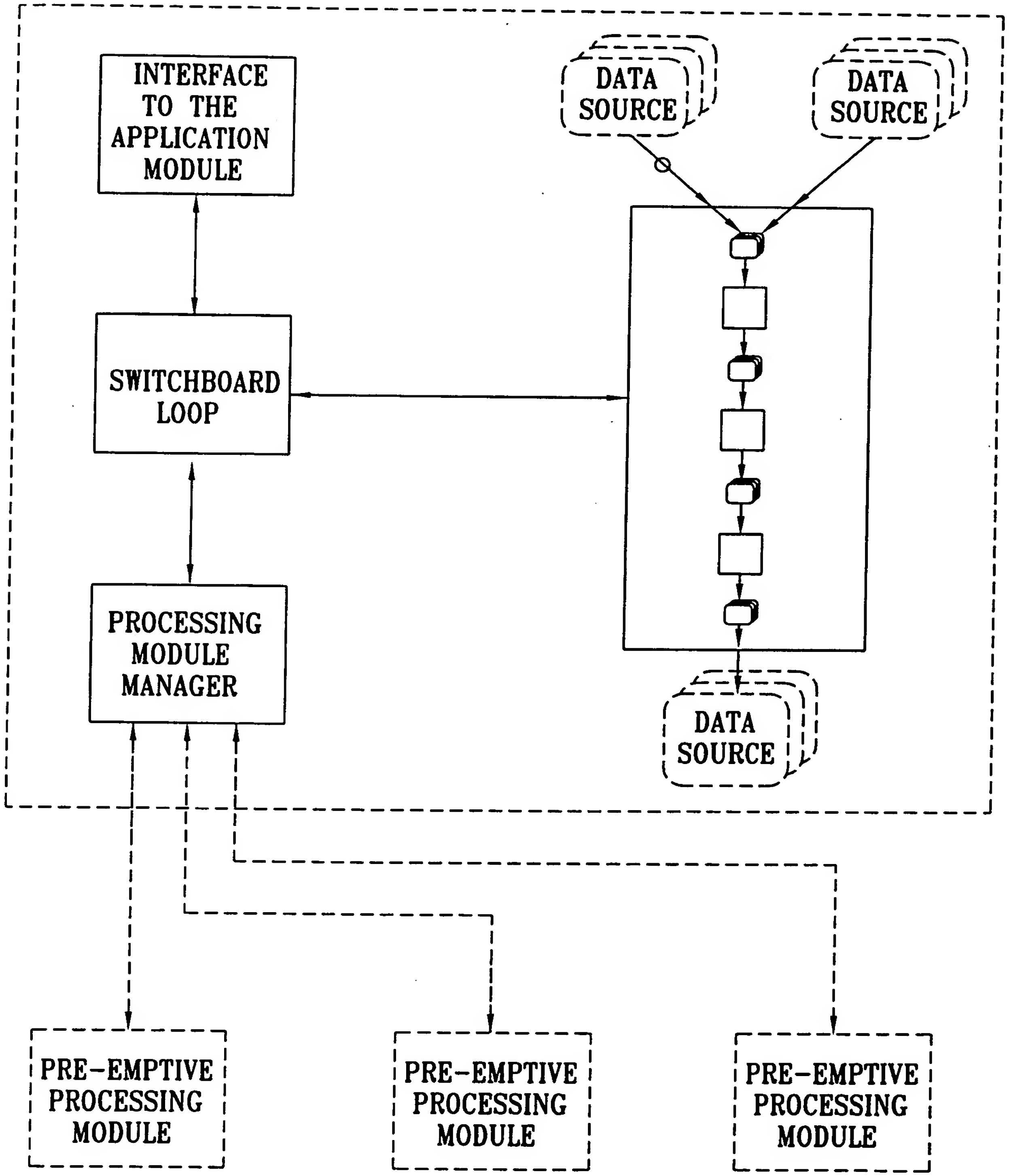

INTERFACE TO THE APPLICATION MODULE
DATA SOURCE
DATA SOURCE
SWITCHBOARD LOOP
PROCESSING MODULE MANAGER
DATA SOURCE
PRE-EMPTIVE PROCESSING MODULE
PRE-EMPTIVE PROCESSING MODULE
PRE-EMPTIVE PROCESSING MODULE

FIG. 51

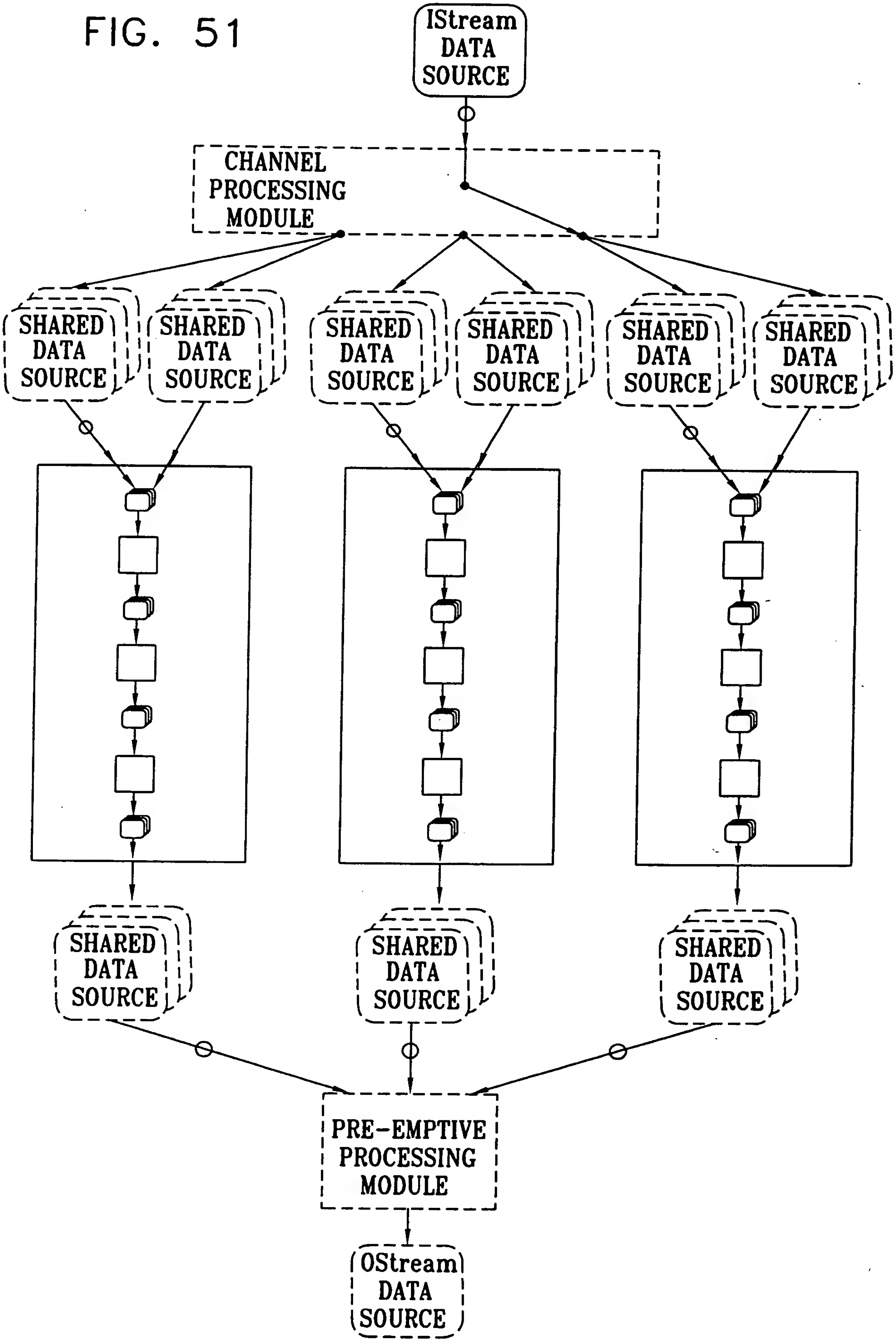

IStream DATA SOURCE
CHANNEL PROCESSING MODULE
SHARED DATA SOURCE
SHARED DATA SOURCE
SHARED DATA SOURCE
SHARED DATA SOURCE
SHARED DATA SOURCE
SHARED DATA SOURCE
SHARED DATA SOURCE
SHARED DATA SOURCE
SHARED DATA SOURCE
PRE-EMPTIVE PROCESSING MODULE
OStream DATA SOURCE

FIG. 52

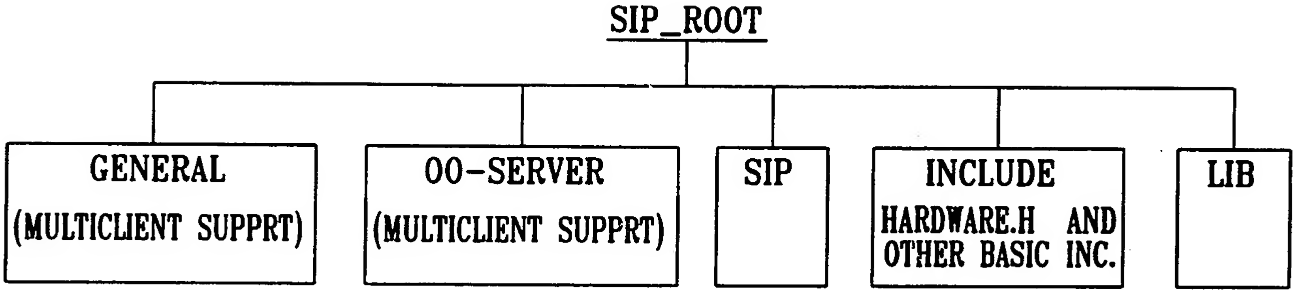

SIP_ROOT
GENERAL
(MULTICLIENT SUPPRT)
OO-SERVER
(MULTICLIENT SUPPRT)
SIP
INCLUDE
HARDWARE.H AND
OTHER BASIC INC.
LIB

FIG. 53

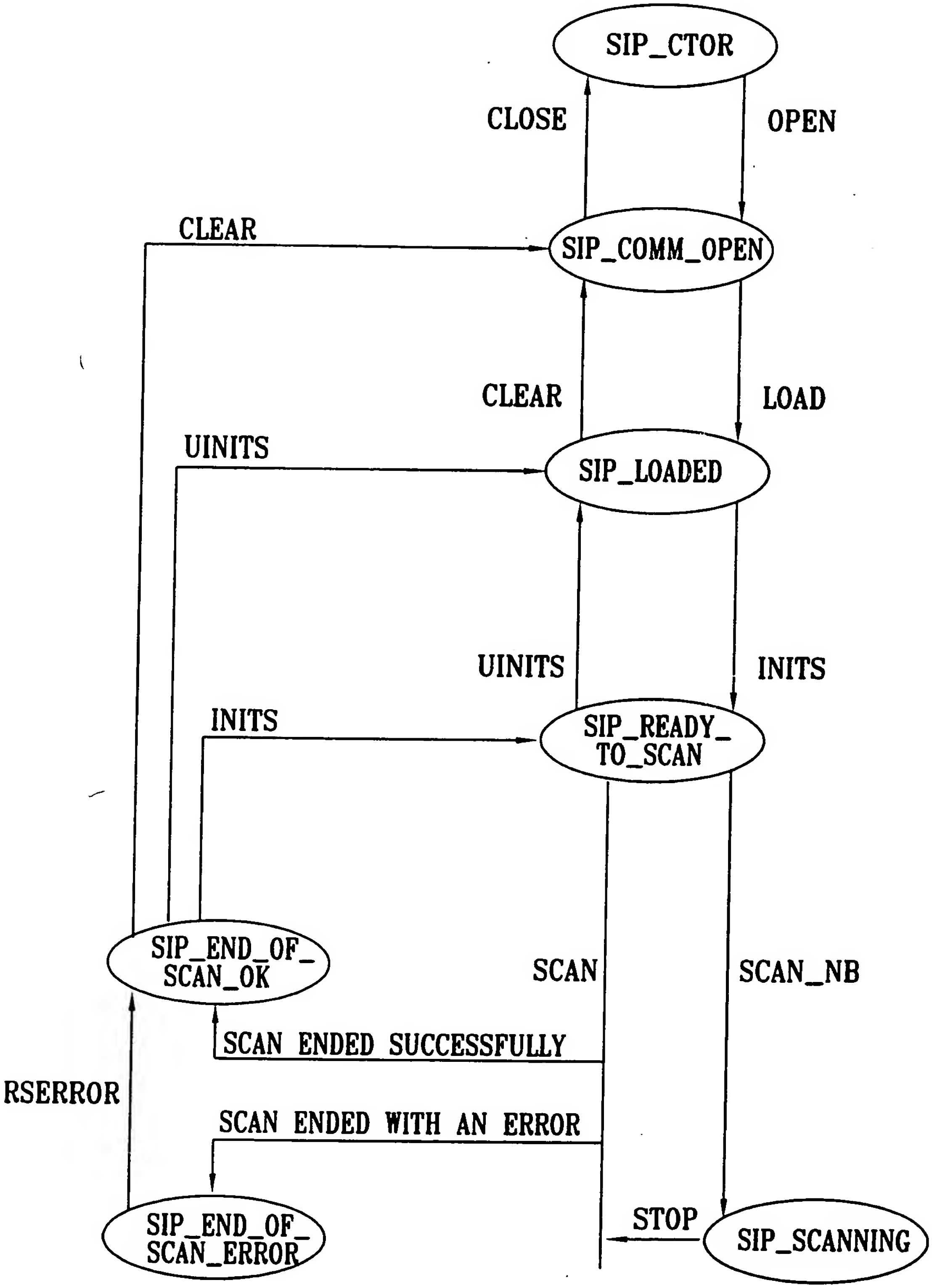
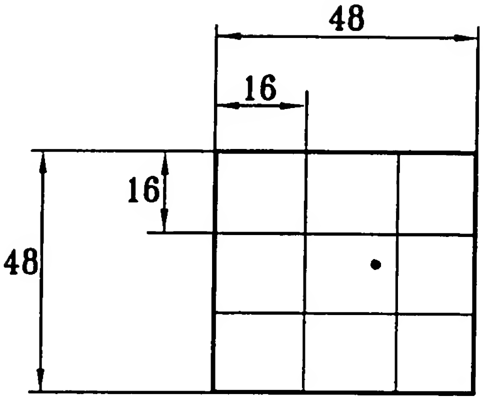
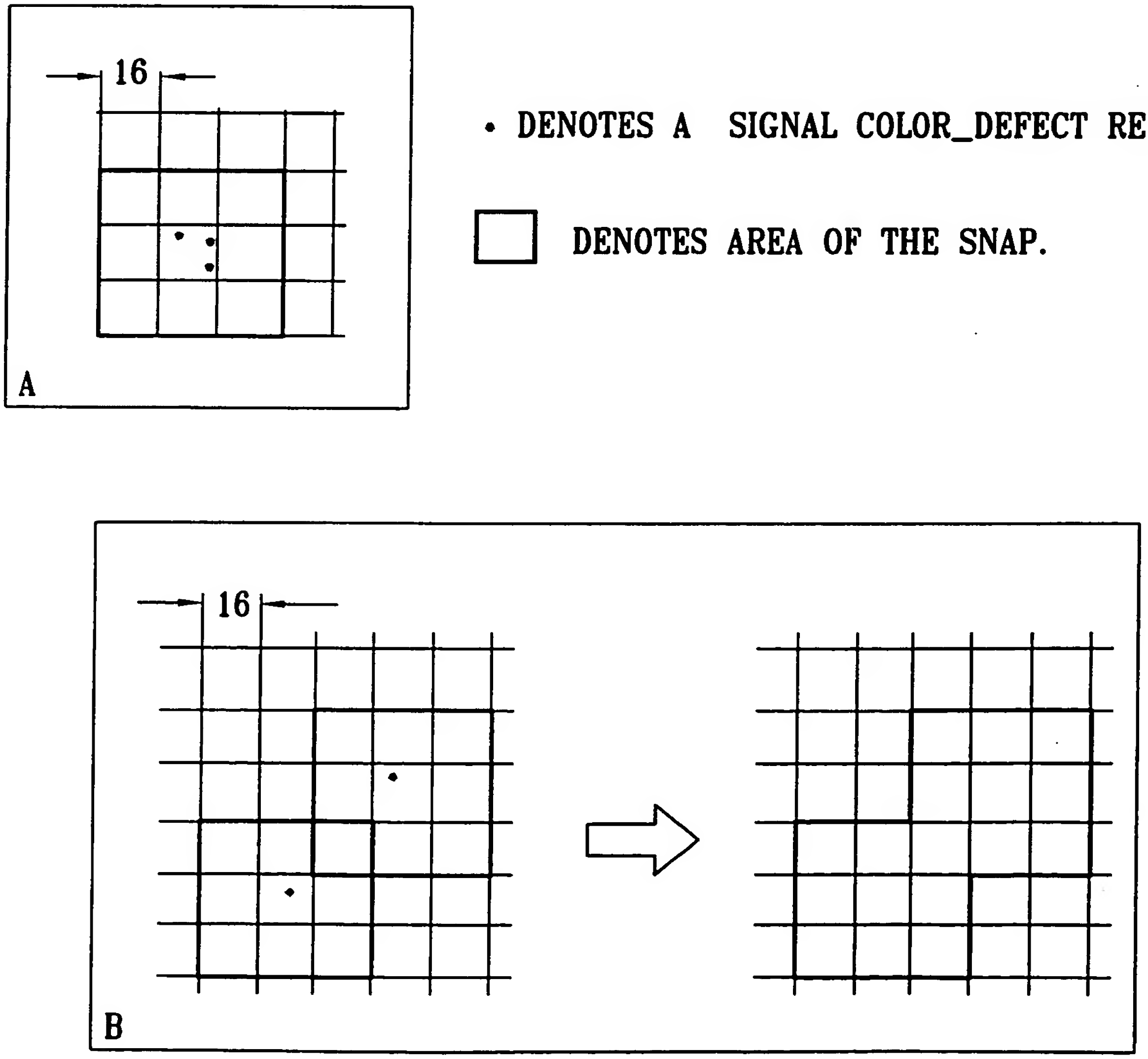

SIP_CTOR
CLOSE
OPEN
CLEAR
SIP_COMM_OPEN
CLEAR
LOAD
UINITS
SIP_LOADED
UINITS
INITS
INITS
SIP_READY_TO_SCAN
SIP_END_OF_SCAN_OK
SCAN
SCAN_NB
SCAN ENDED SUCCESSFULLY
RSERROR
SCAN ENDED WITH AN ERROR
STOP
SIP_END_OF_SCAN_ERROR
SIP_SCANNING

FIG. 54



• DENOTES THE COLOUR DEFECT REPORT DUE TO WHICH THE SNAP OF SIZE 48X48 IS RECORDED.

FIG. 55

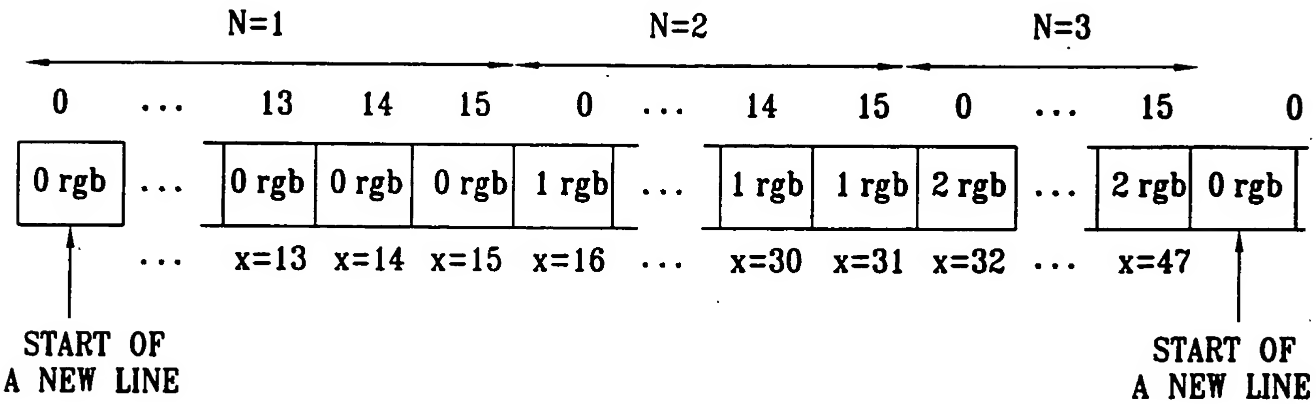


• DENOTES A SIGNAL COLOR_DEFECT REPORT

□ DENOTES AREA OF THE SNAP.

FIG. 56

$X_s$rgb REPRESENTS A SINGLE 32-BIT SNAP REPORT WORD. WHICH CONTAINS THE 8-BIT X-COORDINATE (X_s) AND THE VALUES OF THE RED (r) GREEN (g) AND BLUE (b)


N=1
N=2
N=3
0 ... 13 14 15 0 ... 14 15 0 ... 15 0
0 rgb ... 0 rgb 0 rgb 0 rgb 1 rgb ... 1 rgb 1 rgb 2 rgb ... 2 rgb 0 rgb
... x=13 x=14 x=15 x=16 ... x=30 x=31 x=32 ... x=47
START OF A NEW LINE
START OF A NEW LINE

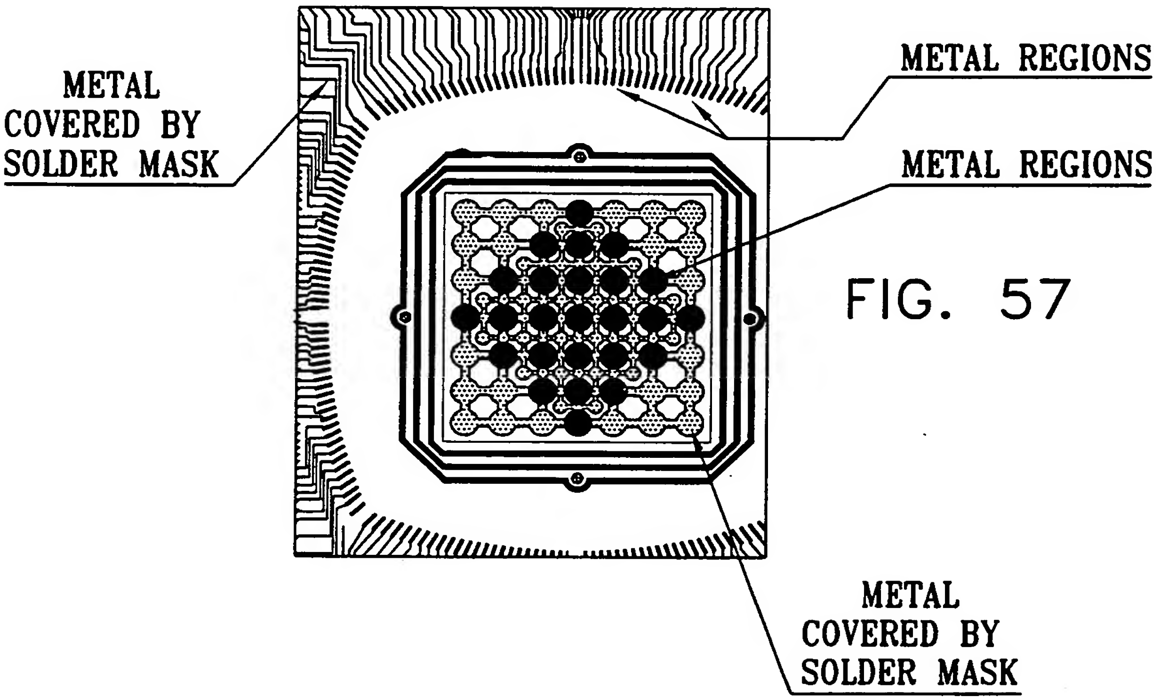


FIG. 57

FIG. 58

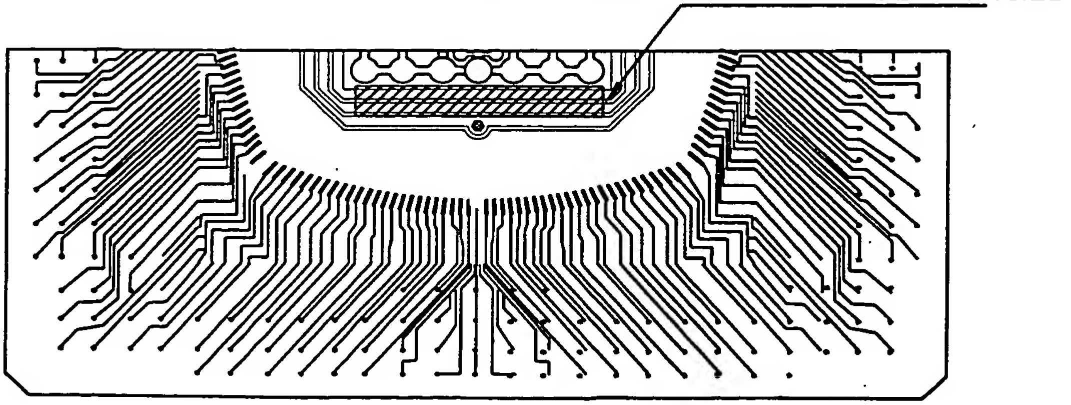


FIG. 59

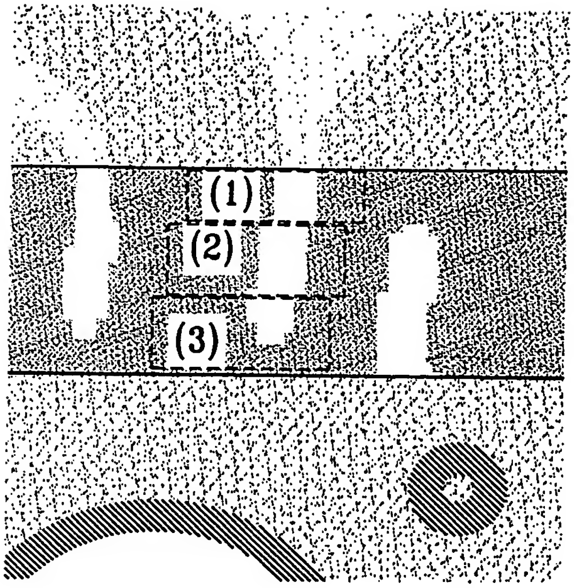


FIG. 60A

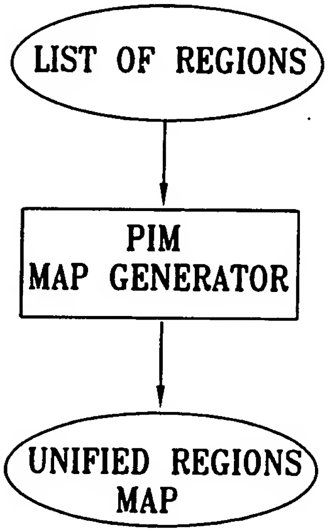


FIG. 60B

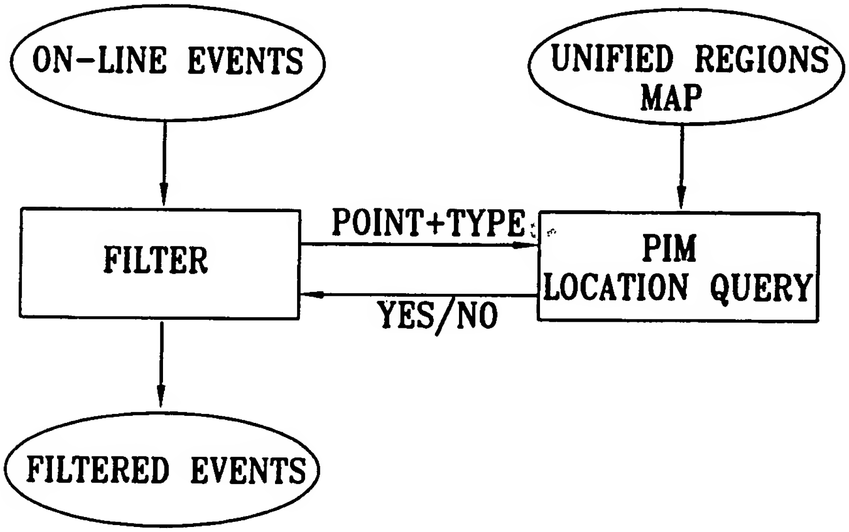
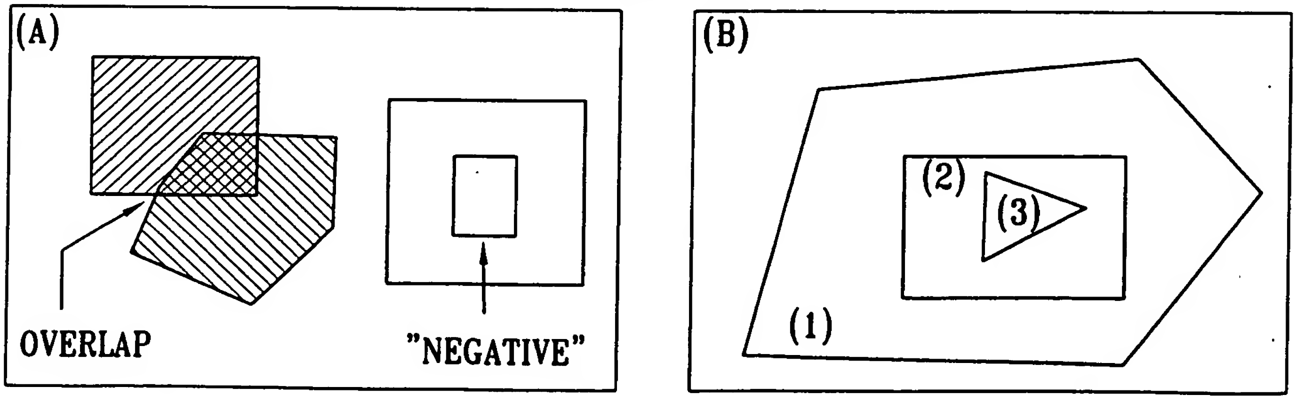


FIG. 61



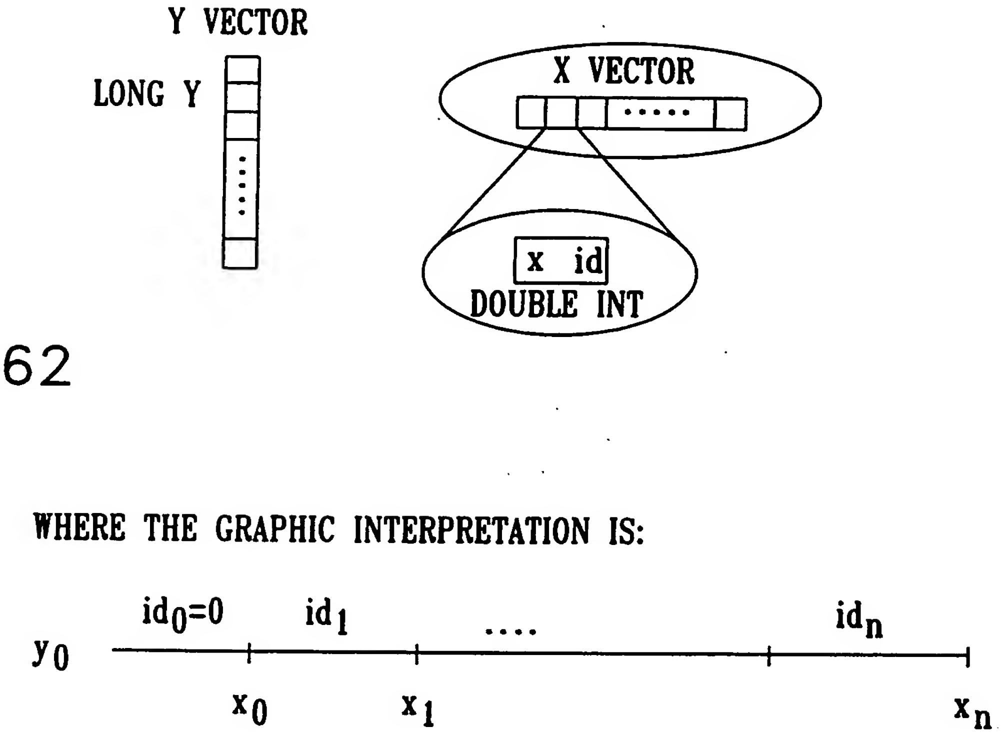

Y VECTOR
LONG Y
X VECTOR
x id
DOUBLE INT
WHERE THE GRAPHIC INTERPRETATION IS:
y_0
$id_0=0$
id_1
....
id_n
x_0
x_1
x_n

FIG. 62

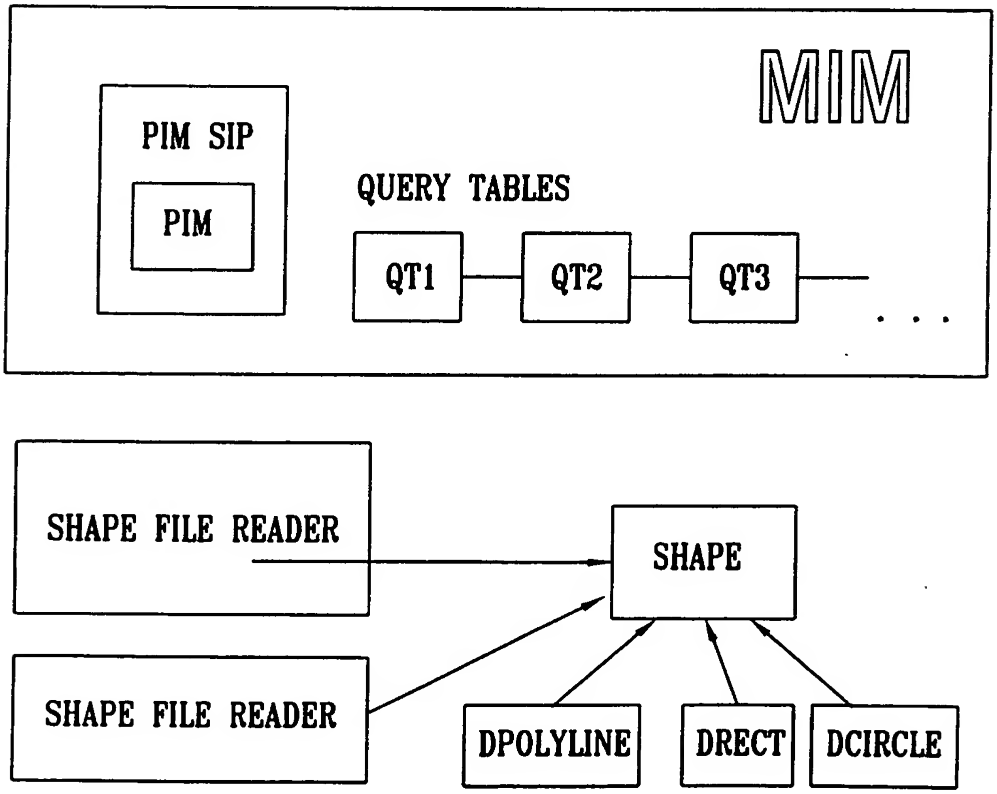

MIM
PIM SIP
PIM
QUERY TABLES
QT1
QT2
QT3
. . .
SHAPE FILE READER
SHAPE FILE READER
SHAPE
DPOLYLINE
DRECT
DCIRCLE

FIG. 63

FIG. 64

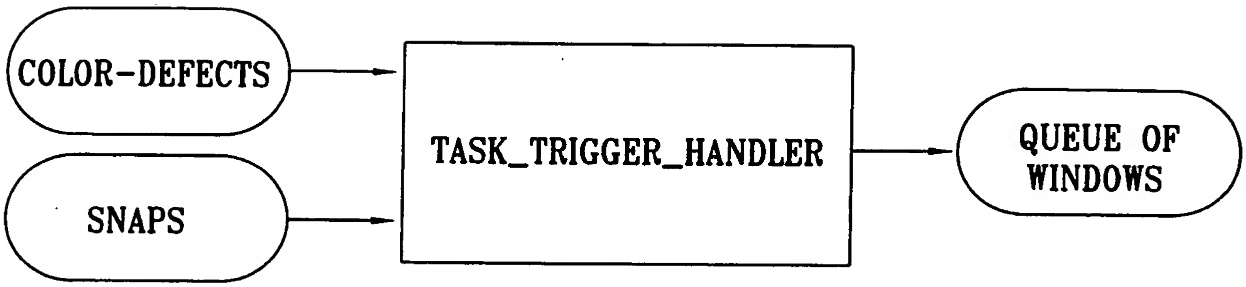

COLOR-DEFECTS
SNAPS
TASK_TRIGGER_HANDLER
QUEUE OF WINDOWS

FIG. 65

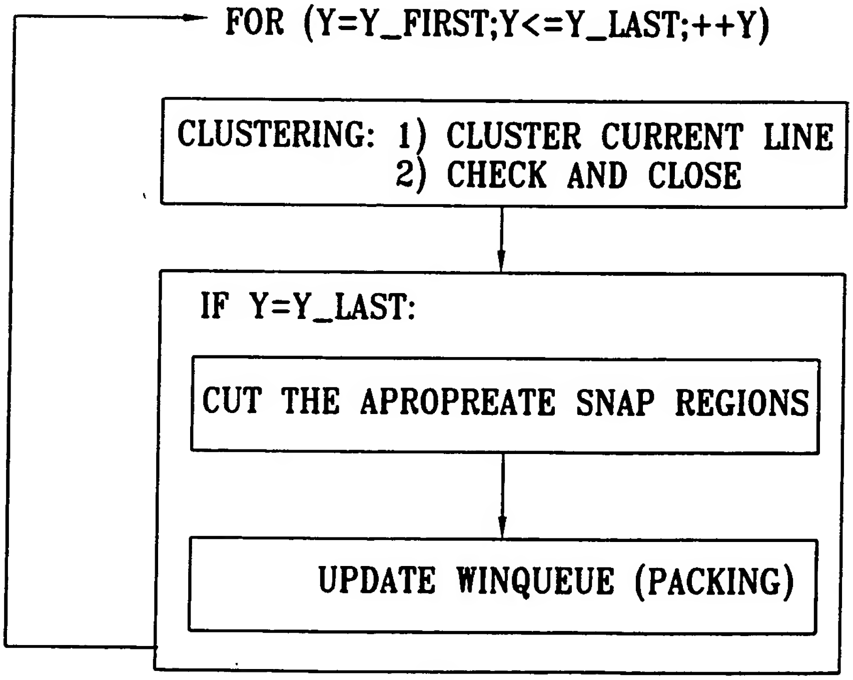
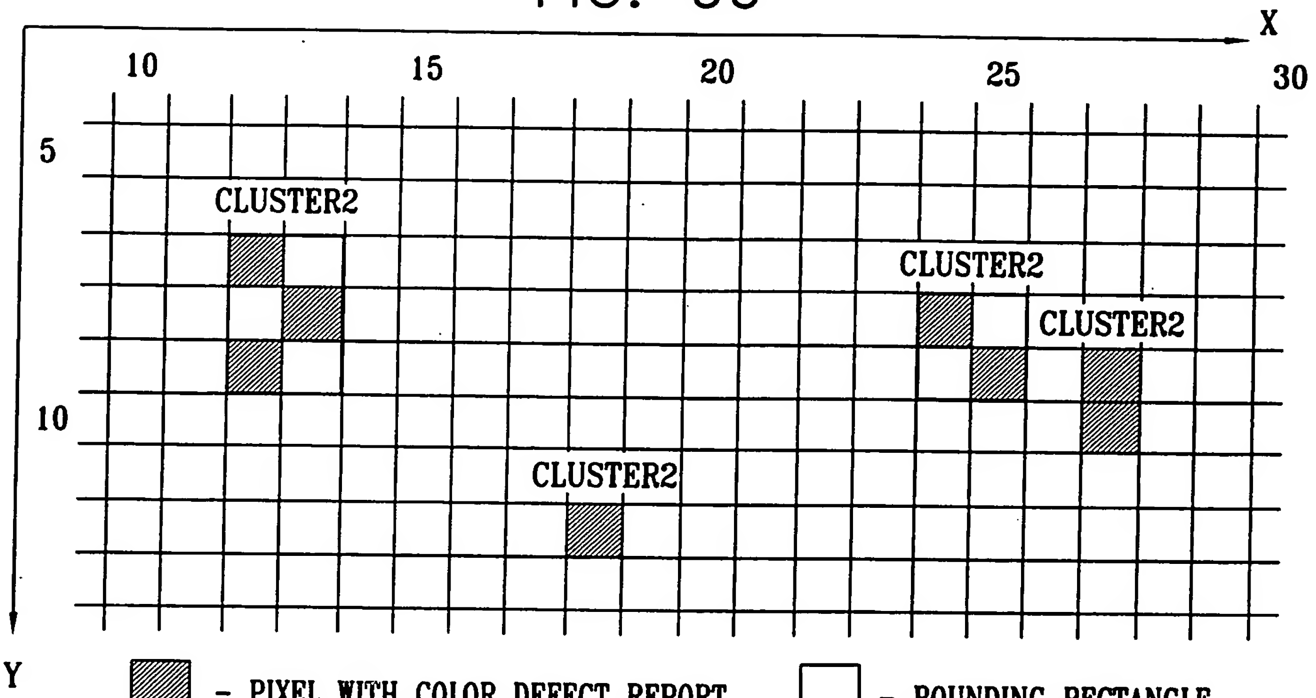

FOR (Y=Y_FIRST;Y<=Y_LAST;++Y)
CLUSTERING: 1) CLUSTER CURRENT LINE
2) CHECK AND CLOSE
IF Y=Y_LAST:
CUT THE APROPREATE SNAP REGIONS
UPDATE WINQUEUE (PACKING)

FIG. 66



▨ - PIXEL WITH COLOR DEFECT REPORT □ - BOUNDING RECTANGLE

THE RUN LENGTH STRUCTURE FOR THE CASE WHERE THE SNAP REGION IS THE BOUNDING RECTANGLE ENLARGED BY TWO PIXELS ON EACH SIDE:

Y=5	10'o'1	15'c'1						
Y=6	10'o'1	15'c'1	22'o'2	26'o'2				
Y=7	10'o'1	15'c'1	22'o'2	25'o'3	26'c'2	29'c'3		
Y=8	10'o'1	15'c'1	22'o'2	25'o'3	26'c'2	29'c'3		
Y=9	10'o'1	15'c'1	22'o'2	25'o'3	26'c'2	29'c'3		
Y=10	10'o'1	15'c'1	16'o'4	20'c'4	22'o'2	25'o'3	26'c'2	29'c'3
Y=11	10'o'1	15'c'1	16'o'4	20'c'4	22'o'2	25'o'3	26'c'2	29'c'3
Y=12	16'o'4	20'c'4	25'o'3	29'c'3				
Y=13	16'o'4	20'c'4						
Y=14	16'o'4	20'c'4						
• • •								

FIG. 67A

THE SNAP RECTANGULAR REGIONS (COLORED AREAS)
THAT WERE CUT ACCORDING TO THE CLUSTERS

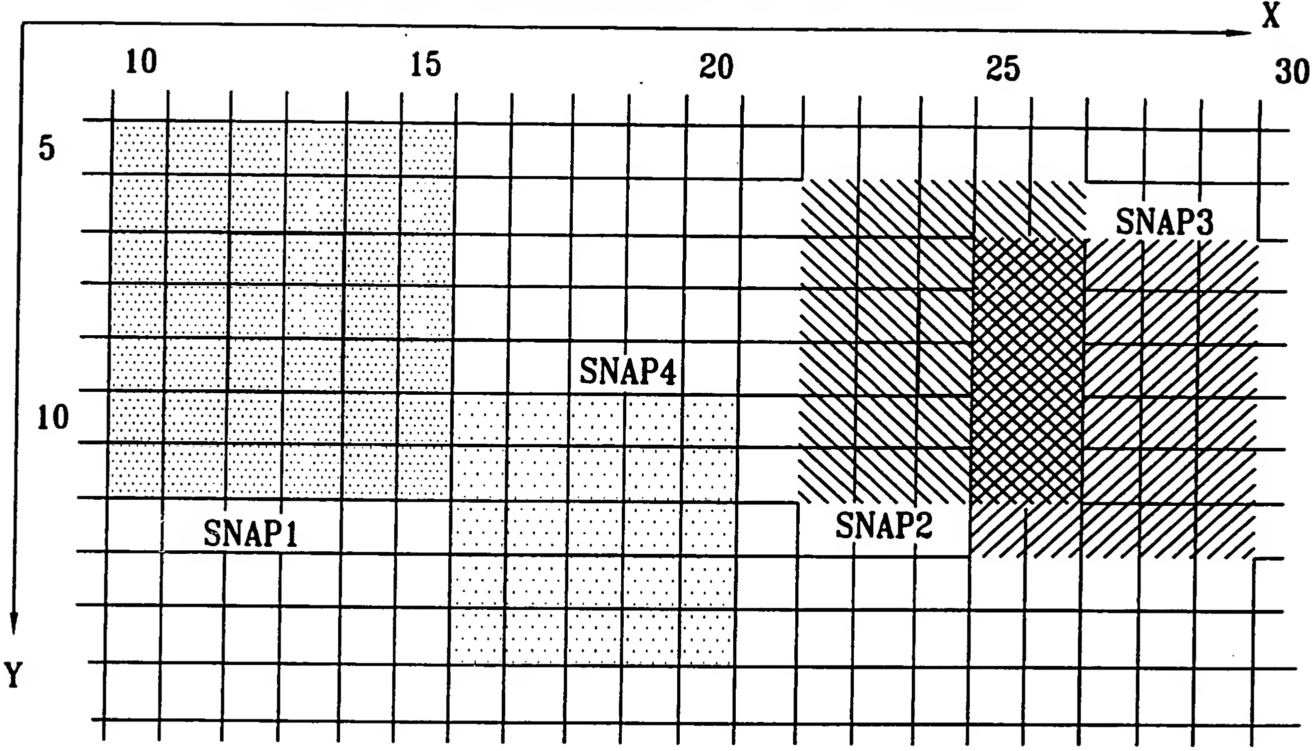


FIG. 67B

THE RESULT IS 4 WINDOWS, EACH POSSESS THE CLUSTER
AND A RECTANGLE WITH THE RED-DATA.

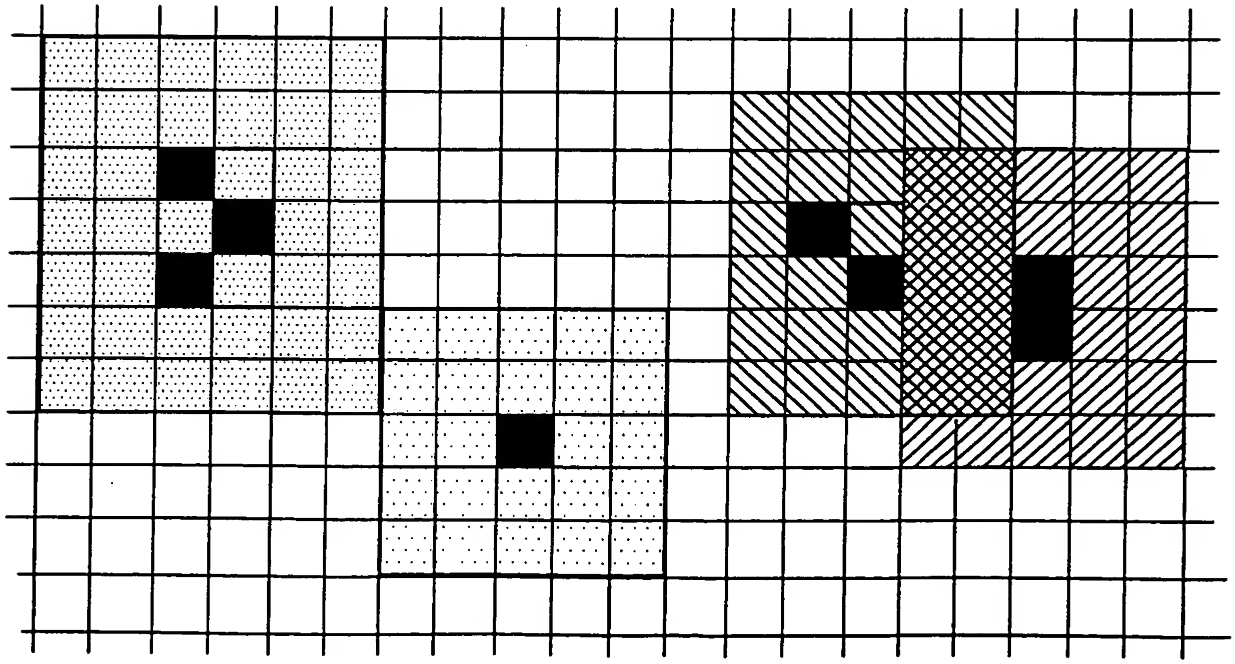


FIG. 68

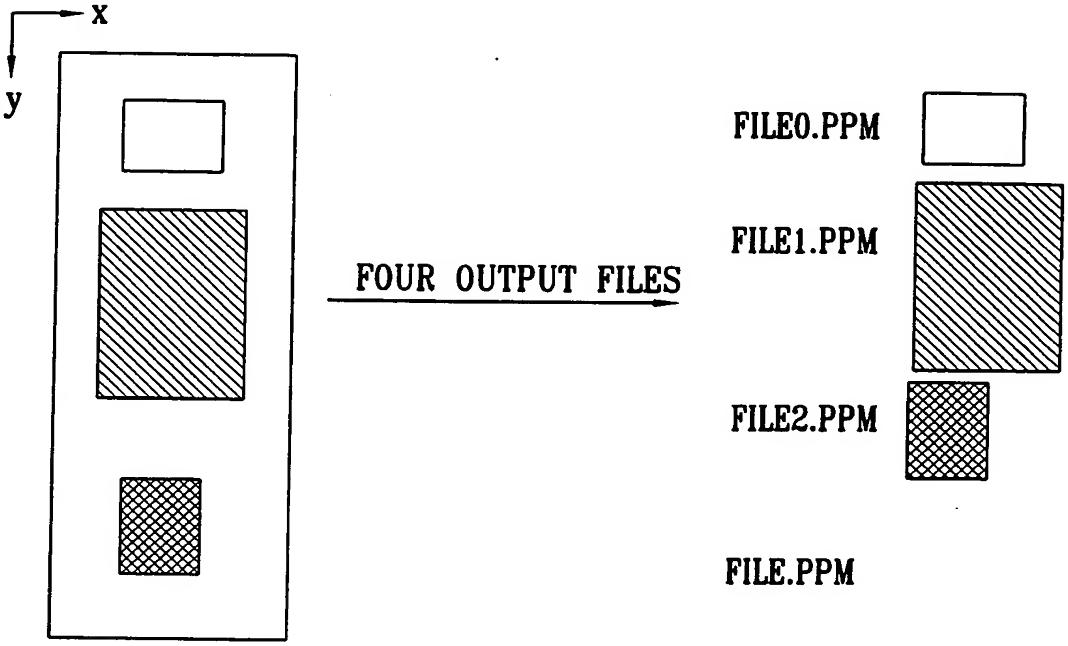


FIG. 69

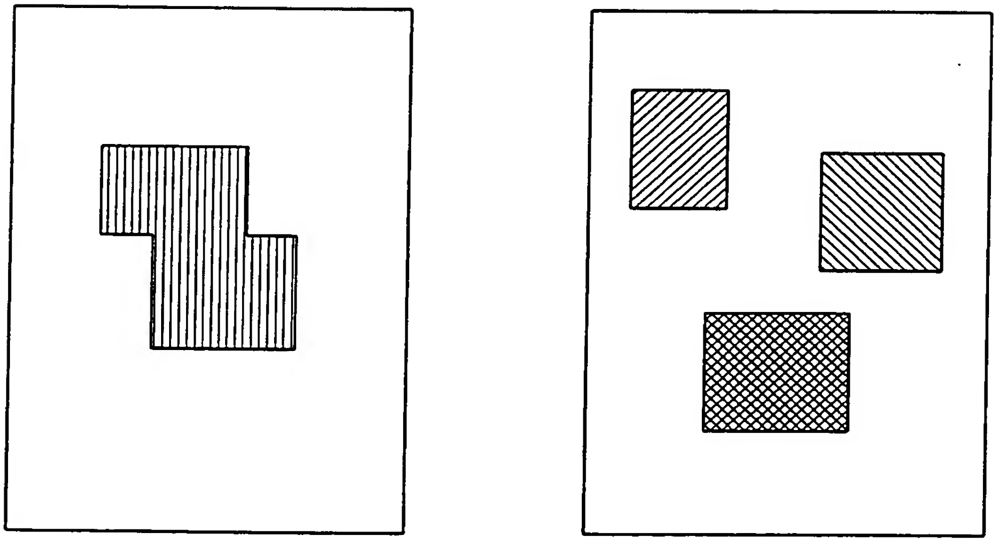


FIG. 70

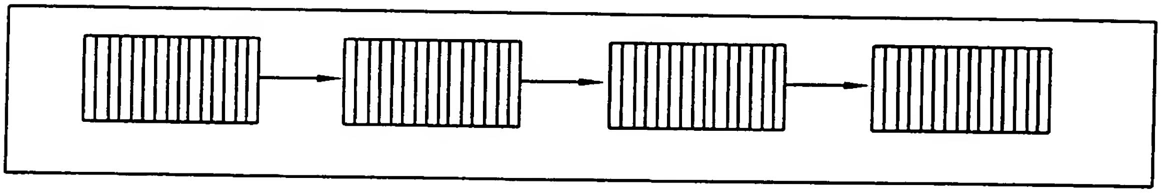


FIG. 71

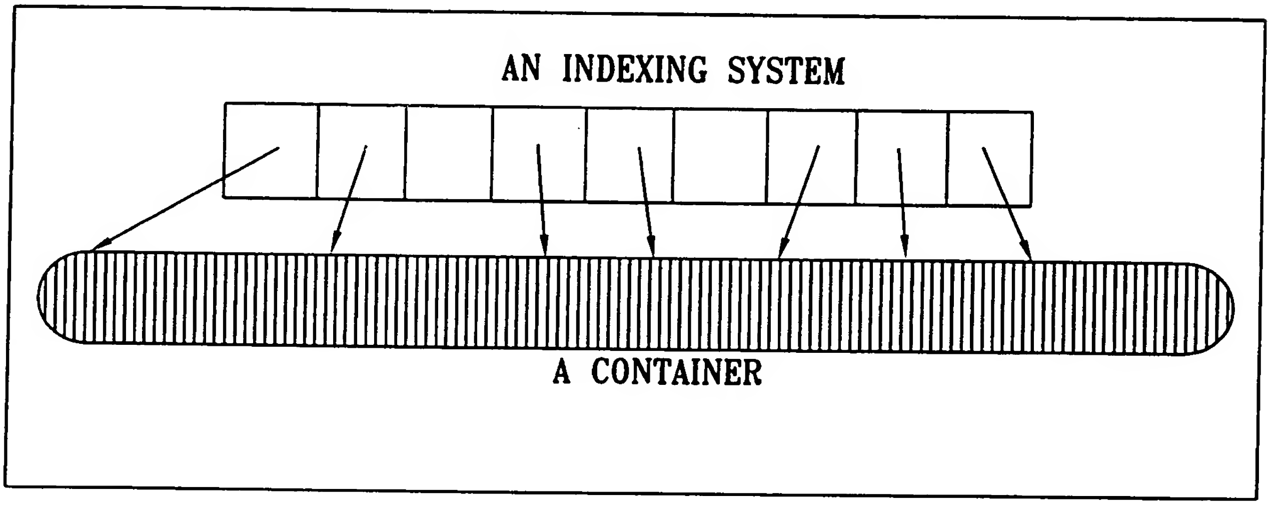


FIG. 72

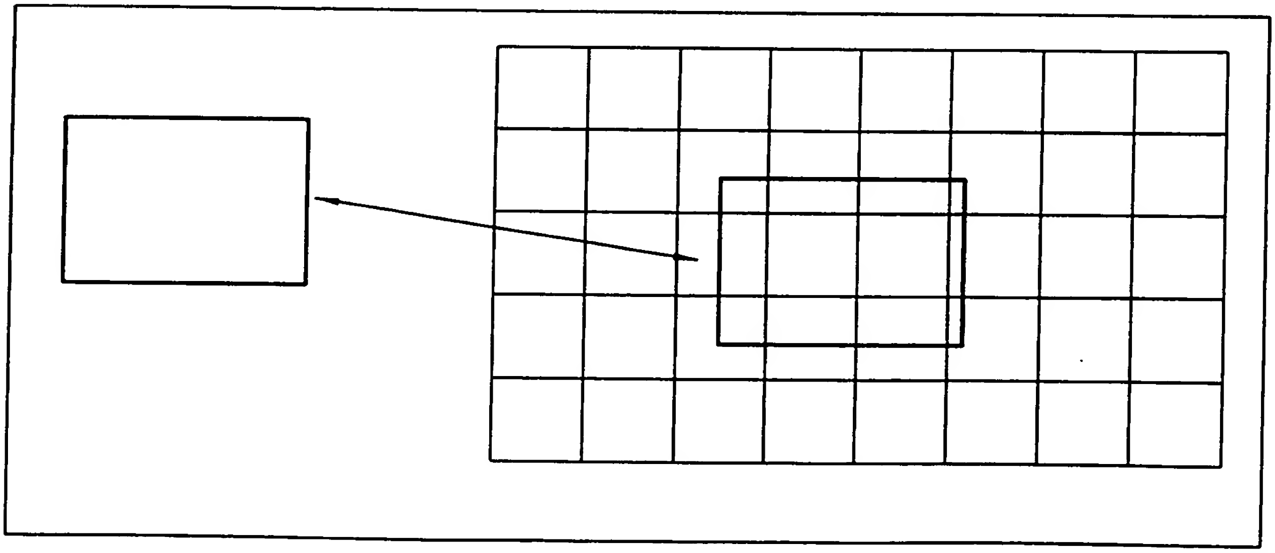
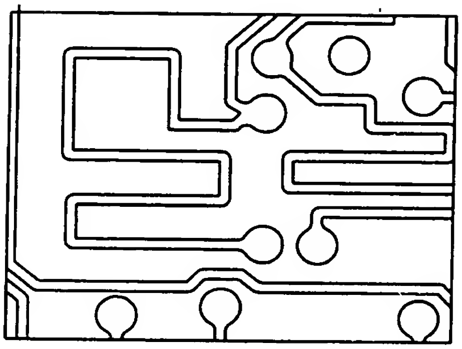


FIG. 73



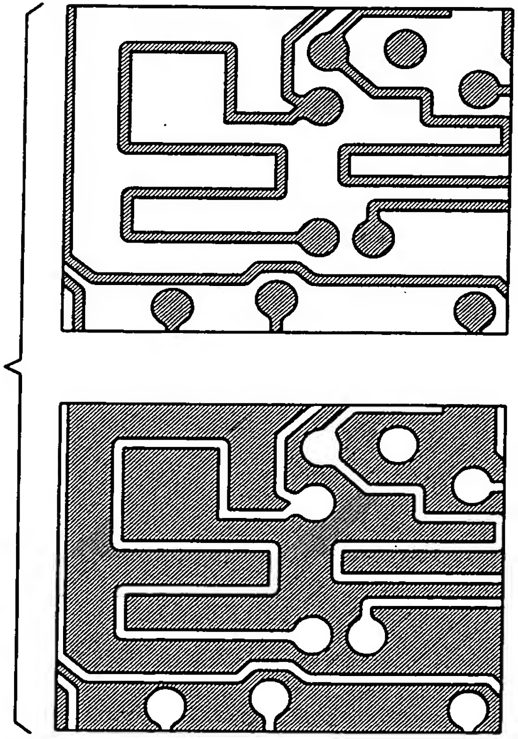


FIG. 74

FIG. 75

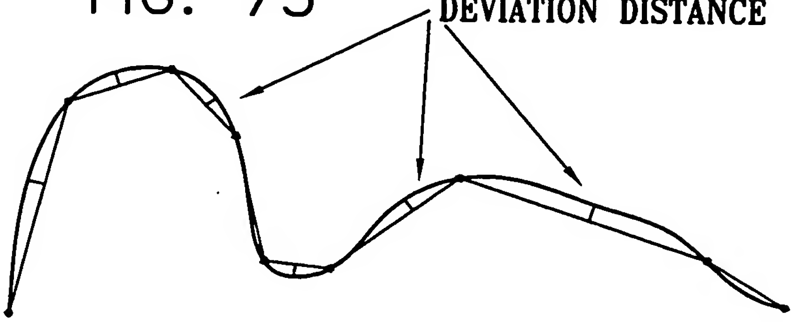


FIG. 76

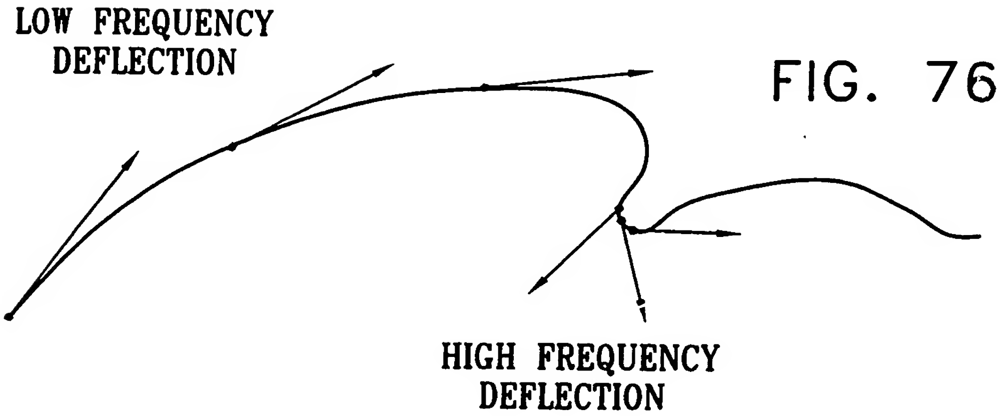


FIG. 77

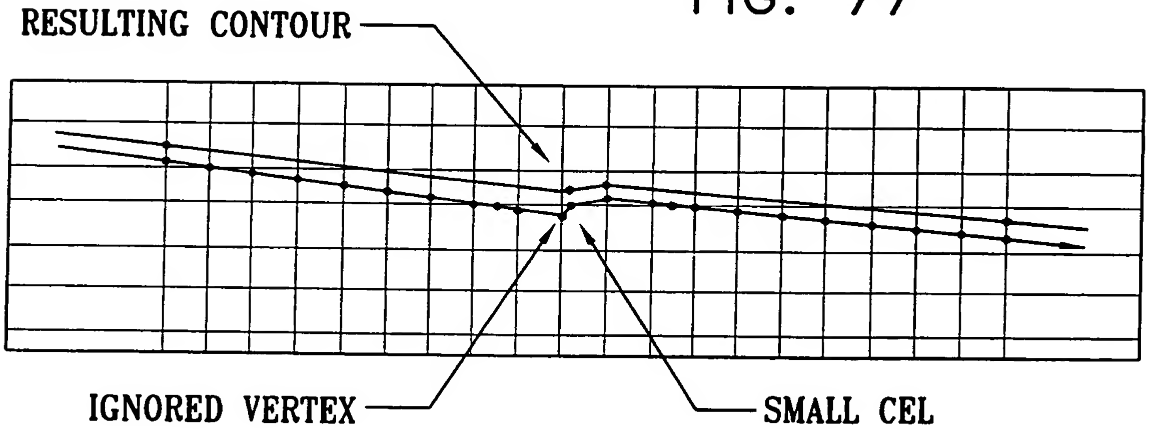


FIG. 78

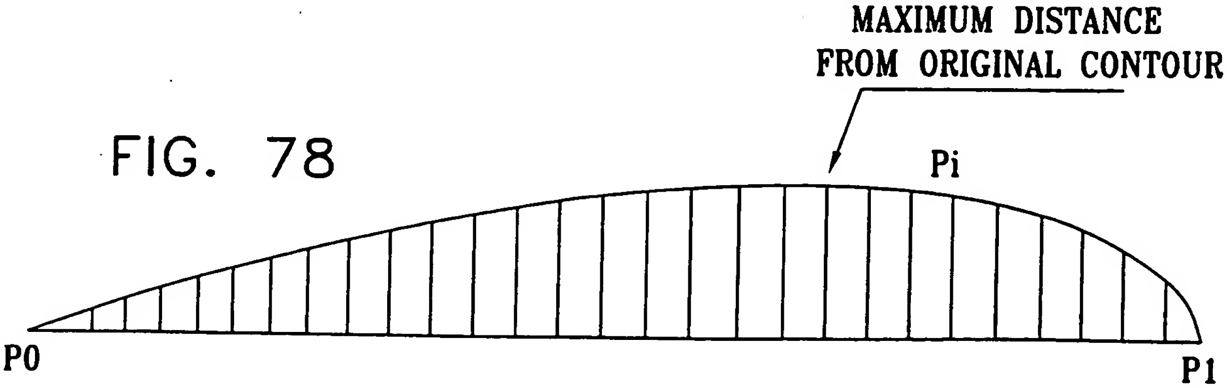


FIG. 79

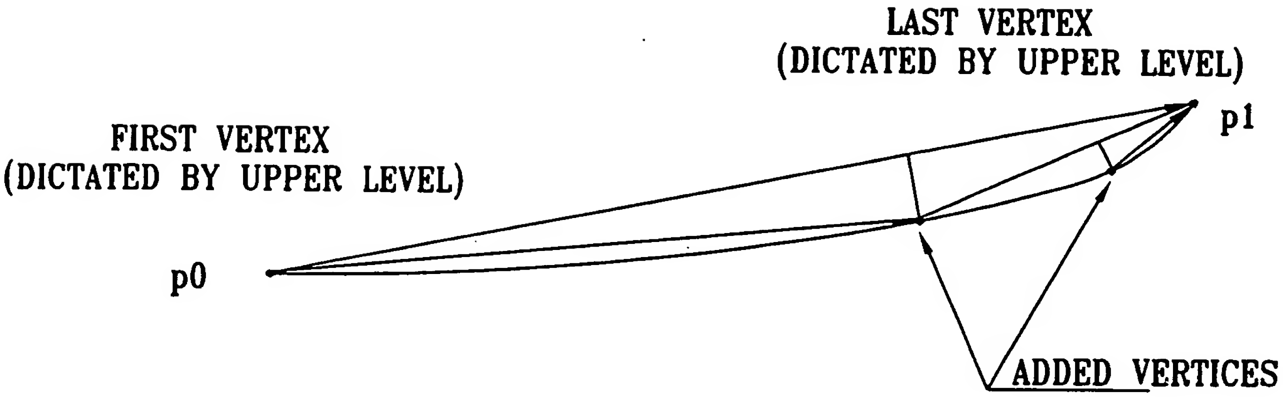

LAST VERTEX
(DICTATED BY UPPER LEVEL)
FIRST VERTEX
(DICTATED BY UPPER LEVEL)
p1
p0
ADDED VERTICES

FIG. 80

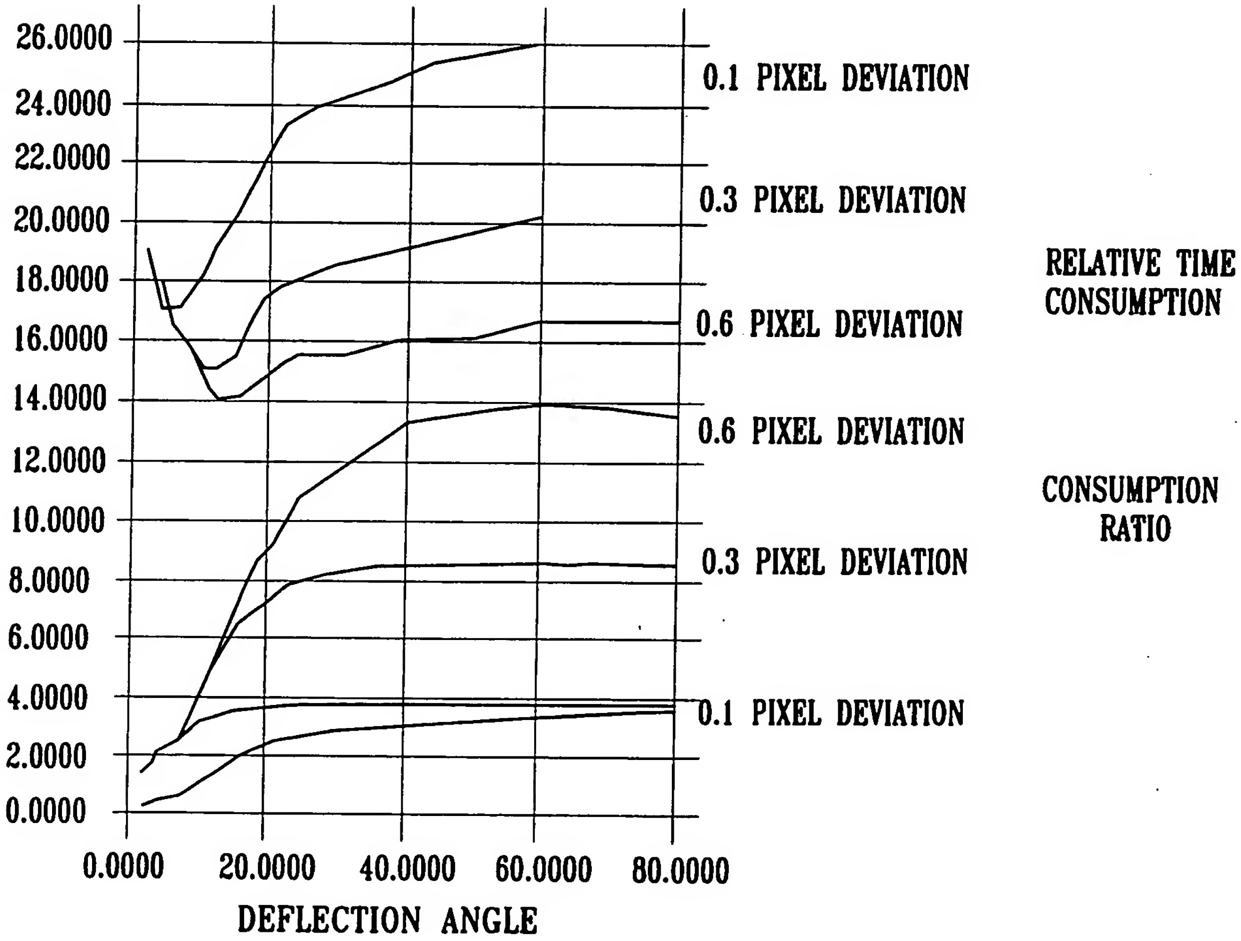

26.0000
24.0000
22.0000
20.0000
18.0000
16.0000
14.0000
12.0000
10.0000
8.0000
6.0000
4.0000
2.0000
0.0000
0.0000
20.0000
40.0000
60.0000
80.0000
DEFLECTION ANGLE
0.1 PIXEL DEVIATION
0.3 PIXEL DEVIATION
RELATIVE TIME CONSUMPTION
0.6 PIXEL DEVIATION
0.6 PIXEL DEVIATION
CONSUMPTION RATIO
0.3 PIXEL DEVIATION
0.1 PIXEL DEVIATION

FIG. 81

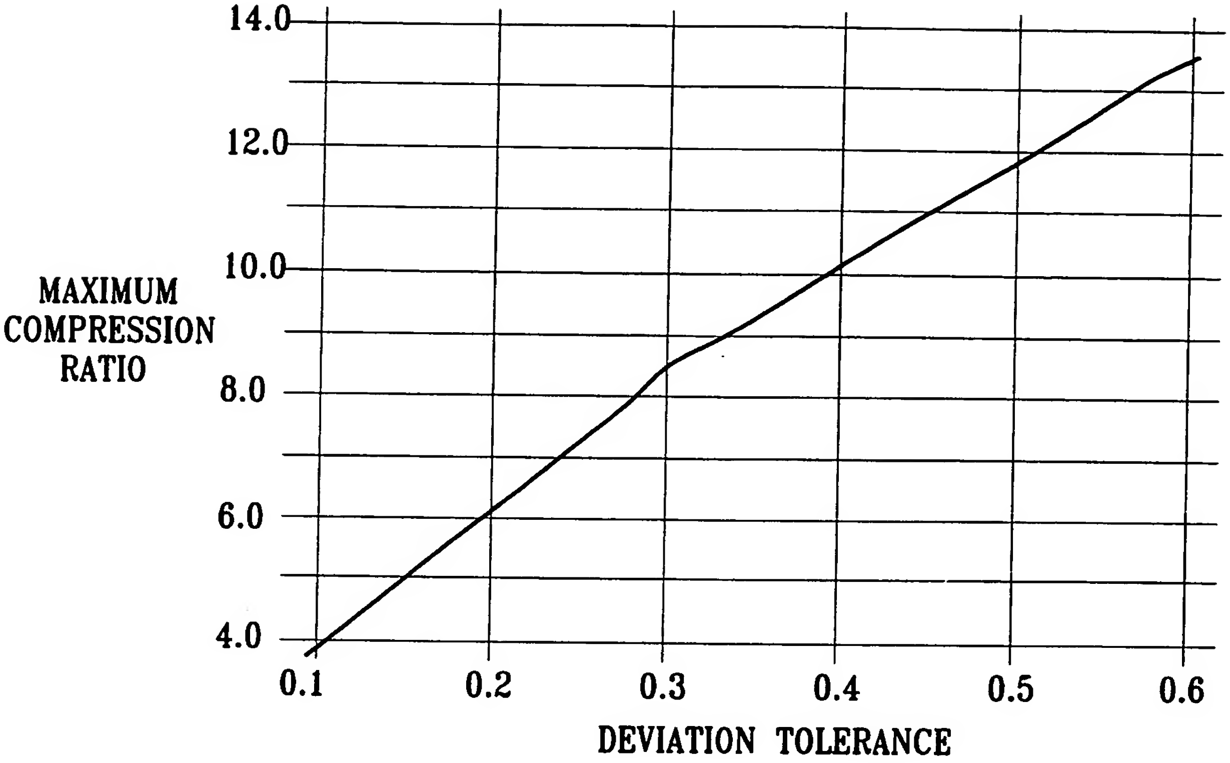
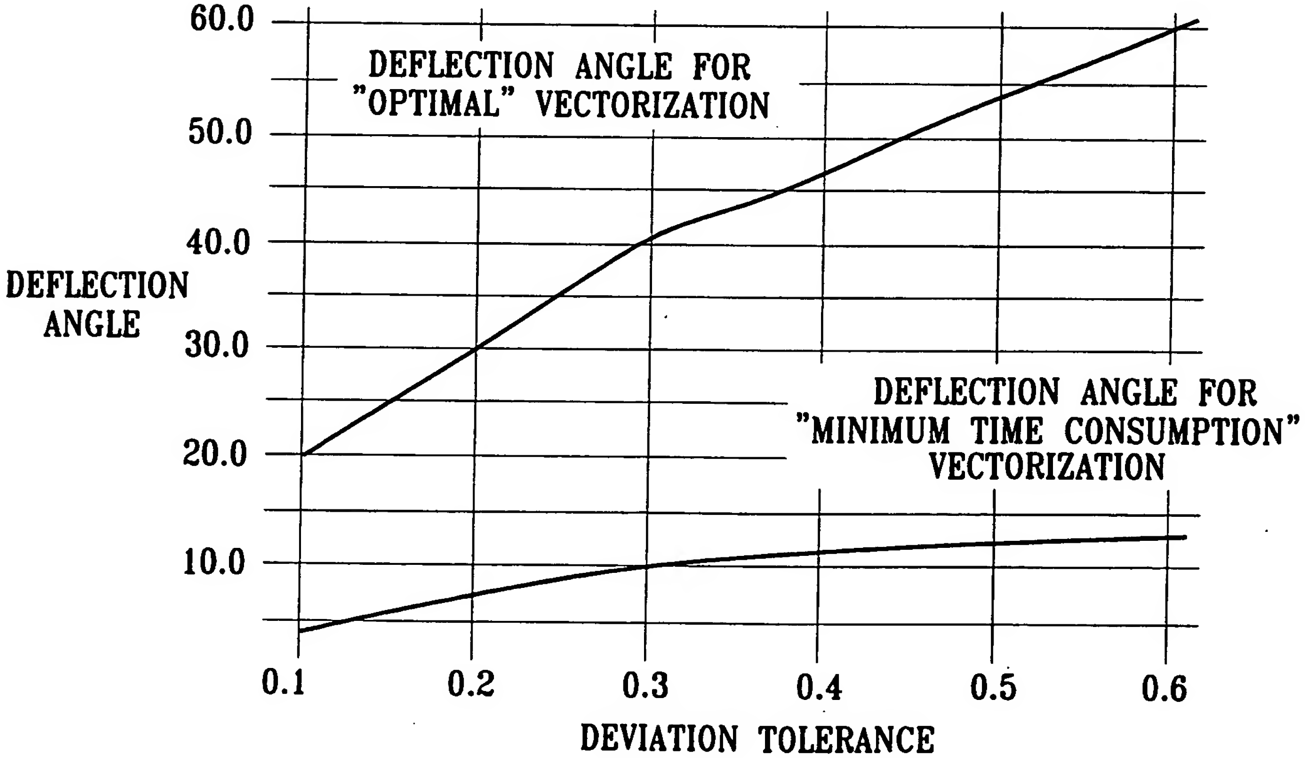

14.0
12.0
10.0
8.0
6.0
4.0
MAXIMUM
COMPRESSION
RATIO
0.1
0.2
0.3
0.4
0.5
0.6
DEVIATION TOLERANCE

FIG. 82


60.0
50.0
40.0
30.0
20.0
10.0
DEFLECTION
ANGLE
DEFLECTION ANGLE FOR
"OPTIMAL" VECTORIZATION
DEFLECTION ANGLE FOR
"MINIMUM TIME CONSUMPTION"
VECTORIZATION
0.1
0.2
0.3
0.4
0.5
0.6
DEVIATION TOLERANCE